

FORESTRY

IN

BRITISH INDIA.

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THE existence and distribution of forests in a country depend, in the first place, on its geographical situation and configuration, and consequent physical conditions, or, shortly expressed, the climate ; and, in a secondary degree, on the interference of man. *Physical possibilities of India as a forest-growing country.*

The question concerning the physical capabilities of India as a forest-growing country can naturally be discussed only in a very general way on account of the vast extent of the empire, and also because the boundary of the reciprocal influence of climate on forest growth and forest growth on climate is debatable ground, on which eminent scientists have taken up the most extreme and divergent positions. It is, however, accepted by all authorities on the subject under consideration, that vegetation, of a greater or lesser luxuriance, can cover the earth's surface only when the conditions permit of a constant evaporation

through the plants, especially during the seasons of growth, and that its distribution and character consequently depend on a supply of moisture by precipitation, overflow, or percolation, in harmony with the temperature of each locality and season.

The sufficiency and suitable distribution of water-supply by precipitation, which we have mainly to consider, result *primâ facie* from the geographical distribution of land and water, as well as from the position, shape, and height of mountain ranges. In consonance with these facts, the surface of the Indian empire may be roughly divided into areas growing evergreen and moist forests, those producing leaf-shedding forests, areas covered with long-rooted trees produced in the dry zone on the high alluvium between two rivers (of which specimens have on several occasions been exhibited), scrub jungle and grasses, and, finally, deserts.

Whatever weight may be granted to the arguments and proofs which will be discussed further on, that the destruction of forests by man's interference has changed the whole climatic conditions of considerable portions of this country, the one fact, amongst many others, must remain unchallenged, that forests can only be grown *again*, without an artificial change of the conditions—such as canal irrigation—*where* forests were once in existence.

India cannot be termed a forest country throughout in the same sense as Europe. Its

position in tropical and sub-tropical zones prevents this; but thanks, on the one hand, to its isolation from the rest of the Asian Continent by the Himalayas, which exclude the dry Central Asian north-east air current, and, on the other, to the peninsular formation of the continent, by far the larger portion of the Empire is adapted for natural forest growth: some areas are eminently so, while others are less so. The country contains, strictly speaking, no extensive *prairie* lands; and its deserts, unadapted for forest growth, which are mainly situated in its north-western portion, cover less than 10 per cent. of the whole area of British India and its dependencies.

The distribution of rainfall is as distinctly marked in India as anywhere in the tropics, and the periodical rainfall extends far to the north of the Tropic of Cancer, with all its characteristic tropical features. The distribution and character of forests in India depend therefore, in the first and highest degree, on the influence of the monsoon rains. These rains come in two periods: the south-west monsoon in the months of June to September, striking first on the whole of the lower western coast of the Peninsula and the western coast of Bengal and Burma; the north-east monsoon in the months of October to December, operating chiefly on the eastern coast of the Peninsula. Some regions are affected by both, others only by one of these monsoons. The coast of the

Carnatic, from the Kistna river southwards and inland to the first ranges of the hills of the Eastern Ghâts, of the Mysore tableland, the Javadi, etc., and even to the very edge of the Western Ghâts, gets its water-supply chiefly from the north-east monsoon, while the south-west monsoon gives it only a scanty and often-failing supply. The western coast districts from the Taptée southwards and the Ghât range behind them get the south-west monsoon in its full force, and so do also the coast lands and outer hill ranges of Tenasserim, Pegu, Arakan, and Chittagong, as well as the plains of Bengal, the outer slopes of the eastern Himalayas, and the Khasi and Tipperah hills. The influence of the south-west monsoon from the Arabian Gulf makes itself also felt, but in a lesser degree, on the western slopes of the Himalayas, while the monsoon rains from the Bay of Bengal travel up almost along the whole length of the great mountain chain. The country which gets both monsoons is therefore only the Peninsula, the inner areas of the Deccan and the Carnatic. In addition to these periodic rains, variations of more or less magnitude occur in different parts of the country, which are often of great local importance.

The above lines give only a general idea of the distribution of the rainfall, which, in accordance with the formation of the country and the distance from the oceans, varies in degree of duration and intenseness: a matter of great

importance, as the character of the forest and the size of the trees vary in direct proportion to the rainfall.

In this respect the country may conveniently be sub-divided into the following four different zones :—

- (i) The *dry zone*, with an average annual rainfall of from 15 to 30 inches, which occupies the large oval plateau-like tract in which the Godavari, the Kistna, and the Cauvery rivers have their sources. It extends from Nasik south-eastwards to below Bangalore, and has an average breadth of from 200 to 250 miles.
- (ii) The *intermediate zone*, with an average annual rainfall of between 30 and 50 inches, which consists of a narrow strip to the west of the dry zone, but includes the whole of the tracts to the north, north-east and east of the latter as far as the Bay of Bengal.
- (iii) The *moist zone*, with 50 to 75 inches of rainfall, forming a narrow belt to the west of the latter along the eastern slopes of the Western Ghâts and embracing also the sea-board of the southern portion of the Gulf of Cambay and the northern part of Travancore.

- (iv) The *wet zone*, having an average rainfall of over 75 inches, which includes the remaining portion of the Ghâts lying to the westward, and practically consists of the western slopes with which the moisture-laden south-west monsoon first comes in contact during its progress north-eastwards.

A map showing this distribution of the rainfall is appended.

Elevation above the sea-level is another important factor as regards the distribution of forest vegetation in India, and naturally so, as it represents every variety of conditions from the tropical to the arctic. Aspect also considerably influences the character of the forests, as do also its concomitants, severe spring frosts on the one hand and scorching winds on the other. Percolation from, and overflow of, rivers cause considerable variety in the forest vegetation over a vast extent of country, and large areas under the influence of tides maintain a separate character of forest vegetation.

The mere difference in latitude, remarkably enough, causes far fewer changes than might be expected, considering that the Indian Empire extends from the 8th to the 35th degree northern latitude. The varieties in the character of forest vegetation in this respect are naturally subject to the same laws as those which in

Europe divide the *Myrtaceæ*, *Laurineæ*, the Olive, Camellias and Oranges from the Lime trees and Beeches and other winter-resisting species; but though many species of trees appear only in the southern part of the Indian Empire, and others only in the northern portion, we look vainly for the abrupt division we find in Europe, accentuated as it is there by the Alps dividing the northern and southern forest flora. That no greater and more abrupt divergence exists in the vegetation is again due to the geographical position, the shape of the Indian Continent, and its isolation by the Himalayas—circumstances which account in a large measure for the tropical features of the climate throughout the country. Certain trees no doubt are characteristic of the more southern regions, such as *Tectona grandis* and *Xylia dolabri-formis*, etc., whereas others are true representatives of the north; but the separation is nowhere abrupt, and, moreover, is more or less obliterated by the occurrence of many species of trees throughout the length and breadth of the Empire.

For purposes of a general description, India may be divided into zones capable of growing—

- | | |
|------------------------|----------------------------|
| (1) Evergreen forests | } due to rainfall
only. |
| (2) Deciduous ,, | |
| (3) Dry ,, | |
| (4) Alpine ,, | due to elevation. |
| (5) Tidal ,, | influence
of tides. |

- (6) Riparian forest due to the over-flow of rivers.
- (7) No forests, due to want of rain, prolonged inundation or excessive elevation.

There are of course areas, frequently of considerable extent within the several forest zones, which for physical reasons, mostly connected with the character of the soil, are unable to bear any forest growth whatsoever, or which can only produce forests of an entirely different character from that indicated by their general geographical conditions. These exceptions may, however, be left out of consideration in dividing the Empire into its broad zones of forest vegetation.

(1) *Evergreen Forests.*

The zone capable of growing evergreen forests comprises four distinct and more or less disconnected parts—

- (a) The West Coast zone.
- (b) The Burma zone, including the Andamans.
- (c) The Sub-Himalayan zone.
- (d) The Carnatic zone.

The first three are within the influence of the south-west monsoon, the last is due to the monsoon from the north-east.

(a) *The West Coast evergreen forest zone* occupies the coast districts of the Konkan, Kanara, Malabar, and Travancore, and the

westerns scarps of the great mountain ranges behind them in the Mahratta country, Coorg, Nilgiri, Anamalai, Cochin, and Travancore hills. In these forests the trees often grow to enormous sizes, the largest of all, perhaps, being *Tetrameles*, *Cullenia*, *Dipterocarpus*, and *Canarium*. The chief families represented are *Dipterocarpaceæ*, *Euphorbiaceæ*, *Rubiaceæ*, *Lauraceæ*, *Myrtaceæ*, *Guttiferæ*, *Anacardiaceæ*, and *Anonaceæ*. The most important timbers are those of *Calophyllum tomentosum*, *Artocarpus hirsuta*, *Cullenia excelsa*, *Xylia dolabriformis*, *Pterocarpus Marsupium*, *Lagerstræmia lanceolata*, *Terminalia*, and, of course, the Teak, which here occurs in the evergreen forest belt. The resins given by *Vateria indica* and *Canarium strictum* are of important economic use, while the Myrabolams (*Terminalia Chebula*) are very largely collected and exported, especially from the Bombay portion. At elevations about 5,000 feet, *Mesua ferrea* and *Hydnocarpus Wightiana* are common. In the higher regions trees of more temperate character appear, and in the upper forests of the Nilgiri and Palni hills, the 'sholas,' as the forests are called, contain members of the families *Ternströmiaceæ*, *Myrtaceæ*, *Lauraceæ*, *Ilicineæ*, and show as chief timbers the Red Cedar, *Gordonia obtusa*, *Ternströmia Japonica*, *Elaeocarpus oblongus*, *Ilex Wightiana* and several species of *Eugenia*. In the dense shade of the big tree-forests of the Ghât slopes, Bamboos and Canes

and Ferns of many species, with evergreen shrubs of the *Acanthaceæ* and *Rubiaceæ* families, are found, and these spread up even into the sholas, where various species of *Strobilanthes*, *Psychotria*, *Hedyotis*, *Loranthus*, with climbing Roses and *Elæagnus*, are common in the undergrowth.

(b) *The Burmese evergreen forests* occupy the coast and the western mountain slopes of the Mergui, Tavoy, Amherst, Kyaukpyu and Arakan districts, broadening and contracting according to the formation of the mountain chains, and spreading into favourably situated moist side-valleys of the Tenasserim, Salween, Sittang, Irrawaddy, and Attaran rivers. They also extend into Bengal, and occupy considerable areas in the coast districts of Chittagong.

The variety of trees in these forests is very great, and the constituents of the forests vary greatly even in contiguous tracts. The height of the trees forming the upper canopy ranges from 150 to 200 feet, the tallest being such species as *Dipterocarpus turbinatus* and *alatus*; *Sterculia spicigera*, *fœtida*, and *campanulata*; *Tetrameles nudiflora*, *Parkia leiophylla*, *Acrocarpus fraxinifolius*, *Albizia Lebbek* and *stipulata*; *Xylia dolabriformis*, and a few other species.

The above are leaf-shedding trees, which tower above the mass of evergreens. Of less lofty trees the variety is considerable, and include such species as *Mesua ferrea*, *Mitre-*

phora vandæflora, *Bursera serrata*, *Kurrimia robusta*, *Stereospermum fimbriatum*, *Vitex peduncularis*, *Adenanthera pavonina*, *Cedrela Toona*, *Lagerstræmia calyculata*, *villosa*, and *tomentosa*; *Mangifera indica*, *Trewia nudiflora*, and these are associated with a host of other species too numerous to detail. Of such as vegetate under the shade of the loftier trees, a few only will be indicated here—such as *Pterospermum*, *Garcinia*, *Xanthochymus*, *Cinnamomum*, *Tetranthera*, etc.

As a rule, tropical evergreen forests which grow on metamorphic rocks are richest in species, while those occurring on the sandstones and other sedimentary less-altered rocks are poorest in this respect.

The shrubby vegetation of these forests is densest along watercourses, in places which have been cleared of the taller trees, and along the outskirts of the forests, almost disappearing in the dark interior.

Climbing Palms are numerous—such as *Calamus latifolius*, *paradoxus*, and *tigrinus*. Bamboos—such as *Dinochola Maclellandii*, *Gigantochloa macrostachya*, *Dendrocalamus longispathus* and *Brandisii*, *Bambusa polymorpha*—are also numerous. Several species of these Bamboos frequently attain a height of 90 to 100 feet. Palms and Screw-Pines are found dispersed throughout these forests.

(c) *Sub-Himalayan evergreen forest zone*.—This occupies the belt of low country bordering

on the spurs of the eastern Sub-Himalayan range, entering deep into their valleys covering the slopes of the lower spurs.

The number of species composing the forest is very great and the trees individually attain a great size, of which the more important are the following :—*Schima Wallichii*, *Terminalia tomentosa* and *myriopteron*; *Artocarpus Chaplasha*, *Cinnamomum glanduliferum*, *Echinocarpus sterculiaceus*, *Bombax malabaricum*, *Dillenia indica*, *Eugenia formosa*, and *Pterospermum acerifolium*. On the lower hills occurs a *Magnolia*, also *Michelia Champaca* and *Duabanga sonneratioides*. At still higher elevations are found *Castanopsis indica*, *Alnus nepalensis* and *Bucklandia populnea*.

The ground in these forests is covered usually with a dense growth of ferns, climbers, and inferior shrubs, which together form a tangled mass, rendering it extremely difficult to penetrate into their interior. In the hilly portions a dense growth of Bamboo (*Dendrocalamus*) occurs, while the valleys are filled with Screw-Pines and Palms. Of the latter, such species as *Wallichia disticha*, *Caryota urens*, *Arcea gracilis*, and *Phoenix rupicola* are conspicuous.

(d) *The Carnatic evergreen forest zone*.—This is a class of forest quite different from the preceding. When in good condition, it presents a dense thicket of close-grown trees, few of any great size, but most of them giving hard valuable woods. More often, owing to careless

cutting, it is reduced to a condition of thorny scrub. The area in which this class of forest is found begins at the Mahanadi and goes down almost the whole length of the eastern coast, the best forests being probably those of Nellore, Cuddapah, and North Arcot. Chief among the trees of this forest are *Mimusops hexandra*, *Diospyros Ebenum*, *Pterospermum*, *Eugenia*, *Memecylon*, *Pleurostylia*; while some few deciduous trees, like *Chloroxylon Swietenia* and *Soymida febrifuga*, occasionally occur. When in bad condition, thorny shrubs, like *Radia*, *Canthium*, *Dichrostachys* and *Zizyphus*, are prominent; but when in good order, these forests are valuable sources of fuel and give some of the hardest woods of the country.

(2) *Deciduous Forests.*

The deciduous forest zone might be divided and sub-divided into numerous zones characterized by typical species, but for our purpose it will suffice to treat of two main classes—

(a) The Central India deciduous forest zone.

(b) The Burma deciduous forest zone.

(a) *The Central India deciduous forests.*—This class of forest, the most important of all, is really the type-forest of India. From the southern slopes of the Punjab Himalayas, eastwards up the valley of Assam, and southwards almost to Cape Comorin, occurs this deciduous forest, varying, it is true, in character and species, but really everywhere obviously the same in general aspect and growth. Some

trees occur in it almost universally, such as the *Terminalias* [*tomentosa*, *Arjuna* (along streams), *belerica*, and *Chebula*], *Lagerstræmia parviflora*, *Butea frondosa*, and *Bombax*. Others are found in more or less local areas. *Anogeissus* does not extend to Northern Bengal, *Pterocarpus Marsupium* and *Bassia latifolia* scarcely cross the Ganges northwards, while *Dillenia* and *Careya* are scarce south of the Kistna. The area of this deciduous forest covers the plains country of the North-Western Provinces, the Terai, the Duars, and Chota Nagpore in Bengal, the hill tracts of Orissa and the Circars, the Central Provinces, Behar, Gujarat, and Central India, Hyderabad, and the east Mahratta country, the Bellary, Cuddapah, and Mysore hills, the hills of Coimbatore and Salem, the eastern slopes of the Nilgiris, Palnis, and parts of those of Tinnevely, especially on slopes of southern aspect. It contains several regions characterized by their principal trees. There is (1) the region of Sâl (*Shorea robusta*), which follows the foot of the Himalayas from the Sutlej to the Borelli, and extends southwards nearly to the Godavari in the Circars and to Nagpur in the Central Provinces; (2) the region of Ironwood (*Xylia doalbriformis*) in the forests of the Circars from the Mahanadi to the Kistna, extending westward into the Chanda district and Hyderabad; (3) the region of Teak (*Tectona grandis*), which commences where Sâl leaves off and extends southwards to the end, embracing

in its general area (4) the region of Red Sanders (*Pterocarpus santalinus*) on the hills of Cuddapah and North Arcot, and (5) the region of Sandal (*Santalum album*) on the hill ranges of Bellary, Coimbatore, and Salem and the northern slopes of the Nilgiris.

Chief among other trees characteristic of these forests are the *Terminalias*, *Lagerstræmia parviflora*, *Anogeissus latifolia*, *Dillenia indica*, *Eugenia Jambolana*, *Ougeinia dalbergioides*, *Soymda febrifuga*, *Chloroxylon Swietenia*, *Pterocarpus Marsupium*, *Diospyros melanoxylon*, *Bassia latifolia*, *Dalbergias*, *Albizzias*, *Bombax*, *Wrightia*, *Garuga*, *Bursera*, *Holarrhena*, and there are many others, while the small male Bamboo (*Dendrocalamus strictus*) is almost universally characteristic. In this same region occur also the Sissoo (*Dalbergia Sissoo*), gregarious along streams in the region between the Himalayas and the Ganges, and the *Acacia Catechu*, or Cutch tree, which, with other species of *Acacia*, such as *Suma*, *Sundra*, *leucophlœa*, is everywhere indicative of a somewhat poor sandy soil. Forming part of this same region, too, is the great Regada or 'black-cotton country,' where the *Acacia arabica* is the common tree, coming up wherever the land lies fallow for a while, and accompanied sometimes by *Albizzia Lebbek*, *Melia indica*, *Poinciana elata*, and *Balanites ægyptiaca*.

(b) *Deciduous forests in Burma*.—These are the typical forests of the drier parts of Burma,

and are unquestionably the most important to the Forester. They occupy that portion of the country, both in plains and hills, in which the climate is drier and the rainfall is less. These forests can be sub-divided into several sections, each characterised by the presence, or absence from it, of certain typical species. It would serve no useful purpose to enumerate those, it being sufficient to state here that, broadly speaking, the deciduous forests of Burma differ but little from the similar class of forests occurring in the peninsular and extra-peninsular tracts of British India. The most characteristic and important species of trees found in the Burma deciduous forests are Teak (*Tectona grandis*), here attaining large dimensions, *Xylia dolabriformis*, *Eugenia Jambolana*, *Bombax insigne*, *Sterculia versicolor*, *foetida* and *viliosa*; *Pterospermum semisagittatum*, *Garuga pinnata*, *Bursera serrata*, *Semecarpus*, *Spondias mangifera*, *Terminalia*, *Anogeissus acuminata*, *Lagerstræmia Flos-Reginæ*, *Briedelia retusa*, *Millettia Brandisiana*, *Cordia grandis*, *Gmelina arborea*, *Dalbergia purpurea*, *Nauclea cordifolia*, *rotundifolia*, etc.

On the lower ground occur such species as *Vitex leucoxylon*, *Bombax malabaricum*, *Kydia calycina*, *Spathodea stipulata*, *Heterophragma adenophylla*; several *Albizzias*, such as *A. odoratissima* and *procera*; *Acacia Catechu*, *Ficus*, *Randia*, *Gardenia*, *Bauhinia*, *Grewia*, *Schrebera swietenioides*, etc. The Padouk tree

(*Pterocarpus indicus*), though occasionally found in evergreen forests, has its real habitat in this class of forests in Burma, as well as in the Andamans. This tree has, perhaps, the most promising immediate future, as it produces, *facile princeps*, the best of all woods for ordnance purposes. Its timber is stronger than Teak in every direction, lasts longer, is much handsomer, and is, on account of its rich colour, highly esteemed for parquetry and wainscoting, and it does not warp in seasoning. The only objection is its weight, which is 15 to 20lb per cubic foot in excess of that of Teak. In the Andamans this tree attains very large dimensions.

Herbage and shrubbery, though not dense, are more conspicuous than in the deciduous forests of the Central India type. Bamboos prevail, of such species as *Dendrocalamus strictus* and *longispathus*, *Bambusa Tulda* and *polymorpha*; and on the lower ground such species as *Cephalostachyum pergracile*, *Gigantochloa albociliata*, and *Bambusa arundinacea* occur frequently in great force. Climbing shrubs are numerous in all the moister tracts, such species as *Butea superba* and *parviflora*, *Entada scandens*, several species of *Vitis*, *Millettia extensa*, *Mezoneurum cucullatum*, being conspicuous. A few palms occur, but are much reduced in size and numbers.

An important though less valuable section of these forests are the Eng or wood-oil bearing

forests, composed to a great extent of several species of *Dipterocarpus*, the principal of which is *tuberculatus*. These forests, in which *Pentacme siamensis*, *Dillenia pulcherrima* and *Shorea obtusa* form quite a feature and which frequently jut out into the evergreen forest zone around them, doubtless owe their origin to the condition of the soil on which they are found.

(5) *Dry forests.*

The dry forest zone occupies two separate regions in—

(a) Rajputana ;

(b) the Punjab.

(a) *The Rajputana region.*—Owing to the limited rainfall, the forest flora of Rajputana is not a rich one, nor are the trees themselves much developed. The province is divided by the Aravalli range of hills into two unequal parts—the part eastward of the range lying in the basin of the Chambal river, and that lying to the westward in the basin of the Indus. The country lying to the east of the range is more or less hilly, and has a climate and forest vegetation somewhat resembling those of Central India and the drier part of the North-Western Provinces. Where not actually hilly, the surface is undulating. To the westward of the central range the country is much flatter and drier, and, as the Sindh and Punjab frontiers are approached, it passes into actual desert.

The forests of Rajputana are in the main

composed of the following species, none of them attaining their full development. Among the largest of the trees may be mentioned *Bombax malabaricum*; among the smaller trees are *Prosopis spicigera*, *Sterculia urens*, *Semecarpus Anacardium*; *Acacia leucophloea* and *Catechu*; *Anogeissus latifolia* and *pendula*; *Dichrostachys cinerea*, *Cordia Rothii* and *Myxa*; *Phyllanthus Emblica*, *Erythrina suberosa*, *Bauhinia variegata*, *Gmelina arborca*, *Boswellia thurifera*, *Butea frondosa*, *Terminalia tomentosa* and *Arjuna*. Climbing plants and shrubs are numerous; among the former are *Cocculus villosus* and *Leæba*; *Celastrus paniculatus*, *Vitis carnosa* and *latifolia*; among the latter are *Mimosa rubicaulis*, *Capparis aphylla*, *spinosa*, *horrida*, and *sepiaria*; *Zizyphus nummularia* and *xylopyra*: several *Grewias*, such as *G. populifolia*, *pilosa*, *villosa*, and *salvifolia*; *Celastrus senegalensis*, *Buchanania latifolia*, *Casearca tomentosa*, and *Diospyros montana* are small trees.

As the western border of the province is approached, the forest vegetation passes into desert forms, of which the more important are *Prosopis spicigera*, *Salvadora persica*, and *Acacia rupestris*.

(b) *The Punjab region*.—The species of trees found in this zone are still fewer, owing doubtless to the fact that, especially in the southern part of the province, which contains the dry forest region, the monsoon rains are still lighter

than in Rajputana. *Acacia arabica*, *modesta*, *leucophlœa*; *Butea frondosa*, *Prosopis spici-gera*, *Tamarix articulata*, *Salvadora persica* are the chief representatives. *Dalbergia Sissoo*, *Albizzia procera*, etc., are found where the water is near the surface. These forests become, towards the hills, richer in species and gradually blend with the deciduous forests and the forests characteristic of the Western Himalayas. On the other side, they disappear in the deserts of Sindh and Bahawalpur, where only the river banks are fringed by arbori-vegetation.

(4) *Alpine Forests.*

The forests of this class may be divided into—

(a) Alpine forests of the Western Himalayas.

(b) Alpine forests of Afghanistan and Baluchistan.

(c) Alpine forests of the Eastern Himalayas.

(d) Alpine forests of Burma.

(a) *Alpine forests of the Western Himalayas.*—The physical features of this region are very varied, and while the lower and outer ranges have a climate not very different from that of the plains of India, the higher peaks, rising, as they do, to over 20,000 feet, are covered with perpetual snow. In the outer ranges the rainfall is heavy, but nearly the whole occurs within a few months, and has not therefore the same effect on vegetation as

if it were more uniformly distributed. It decreases towards the interior of the range, and beyond the snow-line the summer monsoon is represented by a short period of misty weather, actual showers being rare. The zone of heavy rainfall does not extend westward of Dalhousie, and increases in breadth as we proceed eastwards. The vegetation alters with the climate, presenting a very gradual transition from the flora of Nepal to that of the arid Afghan hills.

This influence of climate is much more perceptible on the herbaceous vegetation, and especially on the annual plants which spring up during the rains, than on the trees and shrubs which may be presumed to have greater powers of resistance. Hence *Zingiberaceæ*, *Orchideæ*, *Aroideæ*, and *Begoniæ*, which form so conspicuous a part of the vegetation of the Eastern Himalayas, occur in small numbers in Kumaun, rapidly diminish to the westward, and scarcely extend beyond the Sutloj, thus illustrating the comparative dryness of the climate, although ferns still abound both on the ground and on trees. Again, amongst 25 Indian species of *Artemisia*, two only are found in the Eastern Himalayas; the remainder all grow in the western portion. The vegetation also changes from the outer to the inner and drier ranges, the former being characterised by *Quercus incana*, *Rhododendron arboreum*, and *Pieris ovalifolia*, and the latter by *Pinus Gerardiana* and by *Ephedra*. West of the Ravi the

rainfall has so much lessened, even on the outer hills, that it is only on the range that first rises into the temperate zone that the normal West Himalayan forests of *Quercus incana*, etc., occur; while the valleys immediately north of it, when sheltered by high hills rising continuously to 9,000 or 10,000 feet, present many of the features of the inner Himalayas.

In the temperate parts, many of the trees and shrubs are identical with those found in Europe—for example, Box, Walnut, Yew, Juniper, Ivy, and Mistletoe.

This region has four species of conifers, which are not found in, or only extend for a very short distance into, Nepal or in the Eastern Himalayas. These are—

- (1) *Pinus Gerardiana*, a native of Afghanistan, and of the drier valleys of the Himalayas as far as the Sutlej.
- (2) *Cedrus Deodara*, the Deodar, which has its eastern limit in the extreme west of Nepal, and forms valuable forests, yielding the best timber of these hills. It does not thrive, as a rule, under 4,000 feet, but it ascends to 10,000 feet and in places even to 12,000 feet, its minimum elevation being about 7,000 feet in Kumaun, but descending to 4,000 feet in the Punjab.

- (3) *Cupressus torulosa*, the Cypress, generally found in patches on precipitous limestone rocks.
- (4) *Juniperus communis*, the Juniper, found in all the drier parts of the chain from Afghanistan to Kumaun.

Along the base of the mountains the forest is of a similar character to that of the neighbouring Dúns and Siwálíks. Sál is the chief species, and in places is found as high as 3,000 feet or even higher. Other important trees are *Terminalia tomentosa* and *Chebula*; *Adina cordifolia*, *Anogeissus latifolia*, and *Ougeinia dalbergioides*; whilst *Dalbergia Sissoo* and *Acacia Catechu* occupy the silt deposits of the streams, the latter also occurring scattered on the sides of the hills. *Pinus longifolia* occurs in more or less compact patches, or as individuals in the midst of Sál, *Buchanania latifolia*, *Bauhinias*, *Ougeinia dalbergioides*, etc. As we ascend the mountains, *Pinus longifolia* enters in larger proportion, and new species are met with step by step. On leaving the Sál belt, the commonest tree is *Pinus longifolia*, which becomes gregarious and forms very extensive forests; *Böhmeria rugulosa*, *Bauhinia retusa*, *Engelhardtia Colebrookiana*, and certain species of *Ficus*; then comes the truly temperate vegetation, superseding the subtropical between 4,000 and 6,000 feet. The commonest trees are *Quercus incana*, *Rhododendron*

arboreum and *Pieris ovalifolia*; all of these occur throughout the Western Himalayas, but to the westward they are restricted within gradually narrower limits, and in the extreme west are found only in moist and shady localities, whereas in Kumaun and Garhwal they are most abundant on the drier and hotter slopes. None of them occur in Kashmir. In the valleys and ravines the forest is usually very different, containing such species as *Quercus annulata*, *Celtis*, *Alnus*, *Æsculus*, *Populus ciliata*, *Ulmus Wallichiana*, *Betula acuminata*, *Carpinus viminea*, several Maples, and others. Between 6,000 and 8,000 feet is the chief zone of the Deodar and the Blue Pine, as well as of the Cypress; whilst above 7,000 feet *Quercus dilatata* generally supersedes *Quercus incana*, and small Box (*Buxus sempervirens*) forests occur in damp valleys, especially on limestone. Between 8,000 and 11,000 feet the principal trees are the Himalayan Spruce (*Picea Morinda*), the Himalayan Silver Fir (*Abies Webbiana*), and a third Oak (*Quercus semecarpifolia*); whilst small Bamboos, with numerous *Strobilanthes* and Balsams, are conspicuous features of the undergrowth. One of the last trees met with on ascending to 12,000 feet is a Birch (*Betula Bhojpattra*), accompanied by a tangled undergrowth of a straggling shrubby Rhododendron (*Rhododendron Anthopogon*). Above this again is the Juniper, whilst close to the snow-line all trees and shrubs have

disappeared, their places being occupied by numerous so-called Alpine plants, such as Gentians and Primroses, with mosses and other cryptogams.

(b) *Alpine forests in Afghanistan and Baluchistan.*—As far south as the Kurram valley, the forests still retain much of the character of the Alpine forests of the western part of the West Himalayas. *Cedrus Deodara*, *Pinus Gerardiana*, *Pinus excelsa*, *Picea Morinda* and *Abies Webbiana*, and *Juniperus excelsa* still form the Fir forests; the Oaks have been, however, reduced to *Quercus Ilex* and *semecarpifolia*. *Prunus Padus*, *Rhus sp.*, are amongst the leaf-shedding trees, and *Betula Bhojpattra* occupies many of the higher ridges, where forest vegetation gradually ends in thickets of *Juniperus communis*. Amongst undergrowth and bushes may be mentioned *Viburnum*, *Rhododendron campanulatum*, Wild Roses, *Syringa Emodi* and *persica*, *Cratægus Oxyacantha*, *Fothergilla*, *Cotoneaster bacillaris*, several *Ribes*, etc.

Further south the forest gets poorer and poorer, and is gradually pressed back into high side valleys, the outer hills assuming more and more the character of desert hills, till in Baluchistan proper and the tributaries of the Harnai and the Bolan, *Juniperus excelsa* is the only tree which still forms forests, though in favourably situated positions isolated trees and even groups may be found of the following trees and bushes:—*Pistacia Khinjik*, *Berberis*,

Fraxinus Moorcroftiana, *Cratægus Oxyacantha*.

(c) *Alpine forests of the Eastern Himalayas*.—For purposes of description these may be divided as follows:—

- (1) Oak forests, occupying a belt between 6,000 to 8,000 feet altitude ;
- (2) Rhododendron forests, above 8,000 feet ;
- (3) Fir forests.

The Oak forests consist chiefly of *Quercus lamellosa* and *annulata*, with which are associated *Castanopsis rufescens*, *Magnolia Campbellii*, *Michelia excelsa*, *lanuginosa*, and *Cathcartii* ; several Laurels, Maples and other trees.

Climbers, such as *Thunbergia*, *Crawfurdia* and *Dicentra*, are conspicuous by their bright-coloured flowers. Among the smaller trees are such species as *Phæbe lanceolata*, *Machilus odoratissima*, *Acer Campbellii*, and *Echinocarpus dasycarpus*, all of which yield useful timber.

The Rhododendron forests, in which the trees are gregarious, are only found at elevations above 8,000 feet. The two tree species of *Rhododendron* are *R. arboreum* and *argenteum*, the other species of this genus being either epiphytic shrubs or small terrestrial trees, such as *R. Dalhousiæ*, *Edgeworthii*, *vaccinioides*, *Falconeri* and *barbatum*. Associated with them may be found *Pieris ovalifolia*, *Buddleia Colvillei*, *Hydrangea altissima*, Birches, Maples, and other Alpino species.

The Fir forests consist of *Abies Webbiana* and *dumosa*, associated with which is a Juniper (*Juniperus recurva*).

(d) *Alpine forests in Burma*.—At higher elevations, say from 3,000 or 3,500 feet and upwards, the tropical evergreen forests become greatly influenced not only by the greater dampness, but also by the lower temperature. Tree-growth is here prodigiously developed, and numerous species appear which are absent in the lower levels, such as Oaks (*Quercus*), Chestnuts (*Castanea tribuloides*), and other cupuliferous trees, *Ternströmia japonica*, *Bucklandia populnea*, several species of *Eugenia*, different from those of the plains and coasts; temperate *Laurineæ*, *Ostodes paniculata*, *Podocarpus*, etc. Palms become less conspicuous, and there appear numerous small trees peculiar to this region.

The pine forests are a marked and distinctive feature of this region; at the higher elevation they are quite or nearly free from broad-leaved species; but at a lower level both pines and broad-leaved trees, such as *Eng*, are found intermixed. The principal Pine of this region is *Pinus Khasya*, which occupies the hilly parts of Upper Ava and Martaban. In Upper Tenasserim another Pines makes its appearance at a lower elevation, viz., *Pinus Merkusii*, which occurs chiefly on the sandstone hills of the Thaungyin in Upper Tenasserim.

(5) *Littoral and
Tidal Forests of
Burma and Bengal.*

These forests are situated on the alluvial lands bordering on the sea, and ascend along the larger rivers and their deltas as far as the influence of the tide is felt.

The presence of salt water is the modifying agent as regards the specific forms which characterise the chief components of these forests. Along the sea face itself are the Mangrove forests, consisting principally of *Rhizophoreæ*, such as *Rhizophora mucronata* and *conjugata*; *Ceriops Roxburghiana*, *Kandelia Rheedii*, *Bru-guiera parviflora*, *Sonneratia apetala*, *acida* and *Griffithii*, *Ægiceras corniculata*, and *Carapa obovata*.

Further inland, where the land is inundated only during the spring tides, the Mangrove forests pass into tidal forests, in which the above-named species become more subordinate; while *Sonneratia apetala* and *Avicennia tomentosa* prevail, associated with *Hibiscus tiliaceus*, *Thespesia populnea*, *Heritiera littoralis* and *minor*; *Pongamia glabra*, *Excæcaria Agallocha*, *Phœnix paludosa*, and several other less conspicuous trees. *Heritiera Fomes* (the Sundri tree of the Sundarbans) is the most common and most valuable tree in these forests. Shrubs, such as the following, are much developed:—*Acanthus ilicifolius*, *Clerodendron inerme*, *Pluchea indica*, *Glochidion multiloculare*, and *Ægialitis annulata*, mixed with climbers, such as *Derris scandens*, *uliginosa*, and *sinuata*; *Acanthus volubilis*, and others. *Nipa fruticans*

and *Pandanus fœtidus* locally form dense thickets.

The forests which owe their existence, or at least special character, to the periodical over-^{(6) *Riparian Forests.*}flow of rivers or to direct percolation from them or from lakes, are almost invariably so entirely different from the forest vegetation of the surrounding zone, and are in the aggregate of such large extent, that they deserve to be treated of as a separate class. The character of the riparian forests varies greatly in accordance with their geographical position, and it would no doubt be possible to divide them into numerous classes and sub-classes, every one of them characterized by typical vegetation; but this would lead us far beyond our present aim, which is to give a general and comprehensive idea of the Indian Empire as a forest-growing country. It will meet our purpose to state that the types found in the riparian zones are almost invariably different from those of the surrounding forests, though in many instances they represent a character similar to that found in forests of moister regions.

The swamp forests in Burma represent the one extreme of the character of riparian forests, the forests on the lower Indus, where it winds its way through the Sindh desert, represent the other, and it will suffice if these two extremes are described. Between these two lie the numerous and varying classes of riparian forest-growths.

The swamp forests in Burma are situated on the banks of the rivers, which a considerable distance from the sea form numerous branches, and especially during the rains are entirely free of brackishness, and they are also found on the shores of backwaters and lakes. The soil in these forests is more or less muddy throughout the greater part of the year; during the rains they are inundated, frequently to a considerable depth. The vegetation forms, as in the ever-green forests, three to four distinct strata; the upper canopy is formed by trees such as *Anogeissus acuminata*, *Mangifera longipes*, *Xanthophyllum glaucum*, which, however, is only 70 to 80 feet high. The second stratum is formed by smaller trees and contains several species of *Eugenia*, *Elaeocarpus* (with a fruit which is pickled like an olive) and *Symplocos*. *Cassia Fistula* and numerous other species of interest for the botanist, but not as yet for the forester, are represented and form the third stratum. Amongst the shrubs are found *Capparis distachya*, *Grewia sinuata*, a species of *Combretum* and of *Gardenia*, and many others. The herbage is very scanty and of no special importance, but climbers are plentiful, and in places render the forest almost impenetrable. The most common species are *Jasminum scandens*, *Gmelina asiatica*, *Acacia pennata*, etc.

The riparian forests in the rainless tracts of Sindh are represented by mere fringes of arbori-

vegetation on the river banks, where the rise of the Indus causes the inundation of large riparian areas during the hottest months. Large, valuable and quick-growing *Acacia arabica* forests are the result of these inundations, covering extensive areas of the low-lying alluvium. *Tamarix gallica* forests fringe the banks of all permanent rivers in the Sindh-Punjab zone, interspersed with *Populus euphratica*, *Dalbergia Sissoo* and *Acacia arabica*, which even when no inundations take place are nourished by perennial percolation from the streams. These areas are in the north-west of India known as "sailaba," and are easy of afforestation in spite of the high grasses (*Saccharum Sara* and *Munja*) which frequently cover them.

The forest trees which are found to disappear as the banks of the stream are left, are the *Dalbergia Sissoo* and Poplar. *Acacia arabica* follows next and *Tamarix dioica* takes the place of the smaller *gallica*. Further on, as the stratum of moisture is more remote from the surface, *Prosopis spicigera* and *Salvadora persica* enter into the composition of the forest. *Capparis aphylla* soon after appears; gradually the forest gets more open, the *Salvadora* and *Capparis* more bush-like, and, when even the long roots of these desert trees cannot reach down to the water-level, the last representatives of forest vegetation disappear on the borders of the desert.

(7) *Zones in which
no natural forests
grow.*

These zones comprise the hills above the line of vegetation, rocks too precipitous to carry sufficiently deep soil, areas which on account of too prolonged inundations bear no trees, the deserts comprising plains, plateaus and hills.

The areas which are treeless on account of their elevations are entirely situated in the Himalayas, but those which are barren on account of their declivity are distributed over all mountain ranges of the Empire. The tracts on which no forest grows on account of prolonged inundation are chiefly found in Assam, Bengal and Burma; they are covered with tall grasses, wild plantains and other herbaceous growth, here and there overshadowed by a tall Cotton tree. The desert areas of the Empire are chiefly confined to the drainage area of the Indus, south of the 29th degree; but even in these deserts the courses of perennial rivers are, as already stated, fringed with arbori-vegetation, and though the hills in these zones are barren, small trees and bushes are found in valleys and ravines and in the vicinity of springs.

The blending of the characteristics of the forests of the different zones has already been alluded to on several occasions. It is general, and the boundary between the different classes is nowhere abrupt. The shading off of the various characters into one another is influenced by the aspect; but owing to the large extent of the country and the varying climatical conditions caused thereby, as well as by the differ-

ences in elevation, such influence is by no means constant in the various localities, and in fact is sometimes diametrically opposed in its results in consequence, as the dry heat and especially the scorching winds or the rough northern exposure are injurious to vegetation. The physical qualities, and to some degree the chemical composition of the soil and sub-soil, and the distance of the permanent moisture from the surface also, though in a much less degree, all influence the character of the forest vegetation. Owing to the above conditions, we find not merely a gradual transition of forest of one class into those of another, but it also happens that the different classes jut frequently, with entirely undisturbed characteristics, far into the zone of one another, and that disconnected areas, with all the characteristics of one zone, appear quite outside its general limits within the area occupied by another.

The foregoing paragraphs shortly summarise the physical capabilities of India as a forest-growing country, and not the actual conditions now observable, which to a great extent are due to the influence of man. There can be little doubt that once in the recent post-tertiary period, even within historic times, the greater part of the country now comprising our Eastern Empire was covered with more or less dense forests, populated by aboriginal tribes of hunters. As yet we have based our assertions regarding the forest-growing capabilities of

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India on existing physical reasons only, and on observations made on the existing remnants of former forest growth, but historical indications of the previous forest wealth of the country are not entirely absent.

The Aryan invaders, who are believed to have entered India about 2,000 years B. C., were probably both a pastoral and agricultural people, and to a certain extent denuded the country of its pristine forests. The burning of the Khundava forest, which was in all probability situated between the Ganges and the Jumna rivers, as told in the Mahá Bhárátá, is the first semi-historical evidence of the destruction of the forests by the Kshetriya settlers. Great difficulty was experienced in the destruction of the forests, on account of the frequent rains which Indra poured down to quench the fire—so the legend, which refers to the earliest dawn of Hindu history, tells us. However, though the same epic contains numerous direct and indirect proofs that dark and gloomy forests still covered large portions of the country, even within drier zones along the banks of the Jumna, it is indicated in other parts that the early settlers made a fairly clean sweep on all areas which came under their immediate occupation, and that a terrible drought and famine devastated the country.

The Ramáyána, the second great Indian legend, which treats of a time when an Aryan Empire had been established in Oudh, though

it speaks still of forests, dark as a cloud and very dense, in the wilderness of Taraka, complains already of droughts; and Sringa, the forest-born, was worshipped for bringing rain.

However, even in the north of the Punjab, though it was the first portion of the country in which Aryan settlers developed a stable Government, and from which they spread over the rest of India, we find the Salt Range and the country on the banks of the Jhelum covered with forests dense enough to hide the movements of the armies of Alexander the Great. Arrian, in his history of Alexander's invasion, compiled from notes made on the spot by those who accompanied the king, tells us so, and in describing the conqueror's march further east writes of the country east of the Jhelum that the forests then extended over an almost boundless tract of country, abounding with umbrageous trees of stateliest growth and of extraordinary height; that the climate was salubrious, as the dense shade mitigates the violence of the heat, and that copious springs supplied the land with abundance of water. This description would seem to apply to the Pabbi and probably to the low-lying country between that range and the Chenab, over the northern portion of which *Dalbergia Sissoo* and *Acacia arabica* are scattered even now. This evidence is of considerable importance, because Arrian describes the high *bar** lands of the

* *Bar*.—The high plains table-land between two rivers.

Punjab west of the Ravi—the country known as the Rechnat Doab—much as they were when the British entered the Punjab and as they remained until our magnificent canals transformed them into smiling agricultural districts.

Thus it would seem that during the whole of the Brahminical and Buddhist periods, forests still existed apparently over a considerable part of the country where forests can grow, except only the areas actually under doubtless extensive cultivation in the valleys and near main rivers; and it was only during the constant invasion of new nomadic tribes, culminating in the Mahomedan conquest of a large part of India, that the hills and the country at large were denuded to yield pasture for the extensive herds of the Central Asian invaders. No religious scruples prevented the Mussalman from destroying forests, which his ordinances and communistic precepts declare to be a free gift of Nature, the property of every one, in the same way as water. The nomadic invaders had been accustomed to roam from pasture to pasture; their herds increased; and hills and plains were fired and cleared of forests to create new pastures wherever the nomadic tribes spread. India suffered from Mahomedan incursions in the same way as Persia, Asia Minor, Spain and other countries round the Mediterranean, which were either conquered by Mahomedan nations or came under the influence of nomadic tribes.

It is also probable that in India, as elsewhere, the existing agricultural population were driven during these frequent invasions, with sword and fire, into mountains and forests, and had by force of circumstances to adopt methods of shifting cultivation more destructive to forests than their previous agricultural pursuits—methods which have lasted up to our time, and are most difficult to eradicate.

That the wholesale destruction of forests has had the most deteriorating effect on the climate of India is certain, and sufficient proof of this assertion can be found in the numerous deserted village sites and mounds, indicating the previous existence of a dense population in parts of the country where cultivation is at present found only in the most favourable situations. It may be argued that the depopulation of certain districts was due to political disturbances; but this argument can hold good only in cases where the present physical conditions of the country would now permit the existence of permanent cultivation, such as would be required for settlements on a scale unmistakably indicated by the extensive ruins. It may again be said that such cultivation took place by means of artificial irrigation; but in many cases the level of the country forbids this, and in many others, works would have been required of such magnitude as to leave traces as clear and unmistakable as those of the deserted towns and villages themselves. All this would seem

to prove that the invaders of India did not exterminate an old civilisation, previously found in the north of the Empire, by the destruction of villages and towns and the killing of people, but by the wholesale and continuous firing of the forest vegetation of the country for pastures; and it must be remembered that this was not the work of a day, for at the time when the British Empire, after the battle of Plassey, gradually extended its sway over the whole of the peninsula, invasion by nomadic tribes had gone on for hundreds of years previous to the Mahomedan conquest and the country had been some 750 years under Mahomedan influence.

Though it is evident that the area occupied by forests is much less now than it was some centuries ago, especially in the hilly and more inaccessible parts, there are also numerous examples throughout India that areas once under cultivation have been re-afforested by Nature's unaided efforts, thereby proving that the withdrawal of man's active interference would, under favourable circumstances, be sufficient in time to re-clothe the now denuded areas with forest vegetation, such as clad the country in pre-Vedic ages, before the Khandava and other forests had sunk under the axe and fire of Ksheshtriyan settlers and the Mahomedan invaders. Throughout the Gumsur forests, in the Ganjam District, Madras Presidency, very old Mango and Tamarind trees in groups occur in

the forests; now covered with Sâl trees sometimes of magnificent growth, and probably about 200 years old (or may be a little less). The hills are rocky, and though the rocks are now covered with trees, imagination can easily picture them as bare as are now the rocky hills of Bellary or the coast hills of Vizagapatam. It would seem that the valley was once covered with cultivation and villages, but that a famine, or pestilence, or the raids of the warlike hill-men (Khonds), depopulated it; and hence we find the old Mango trees still left, and the old fields yielding a crop of Sâl. In the recesses of the Chittagong hills in Bengal, in many parts of Assam, especially in the Nowgong District, and between the Mahanâdi and the Joke rivers in the Central Provinces are old tanks and the remains of buildings, temples and palaces buried in dense forests; while even in the Sundarbans occasional traces, like the well-known Jhoteedhole tower (whose origin is completely unknown), show that cultivation, or at any rate habitation, formerly went much further south than it does now.

When, in the beginning, the foundation of the present Indian Empire was laid, and as province after province was added, the forest areas had already, over considerable portions of the country, been reduced far below the minimum necessary for its well-being, and this state of things lamentably increased during the early days of British occupation, whereas

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conditions of a
country.*

other portions were still covered with almost virgin forests.

Now, though it has been admitted in the first part of this introduction that the climate of each country and of each district is *primâ facie* dependent upon its geographical position, its elevation, the configuration of the ground, and other cosmic causes which are independent of local circumstances, it can hardly be denied that the existence or non-existence of large well-wooded areas in a country naturally capable of growing forests affects its climate in a very marked degree. History proves this to us in numerous instances where the deterioration of the climate of whole districts, and even of whole countries, has followed the destruction of forests.

The once well-wooded Dalmatia is a stony desert. Persia, once one of the granaries of the East, is barren and desolate over a large extent of the country. North Africa, formerly one of the main corn markets of Rome, is subject to the severest droughts. Spain, Italy, Sicily, Greece, and Asia Minor have suffered greatly from disforestation; and finally, but not least, India, especially in the intermediate and dry zones in the Deccan and in the north-west of the country, has been injured by the destruction of her forests.

Even Oskar Peschel, who questions the importance of the influence of forest growth on the climate of a whole country, perhaps more

than any other writer of note, throws no doubt on the observations made by Boussingault, Humboldt, and Bompland, and acknowledges the local influence of forests on the precipitation of moisture. He says, however,—and he has numerous followers even within the ranks of the Forest Department—that the amount of rain which falls year by year on the Continent would be exactly the same if there were no forests at all—

“The amount of rain,” he states, “depends on the extent of oceans and seas, on the degree of heat, and on the rapidity with which the air moves over the surface of the waters. None of these conditions are changed,” he writes, “by the extent or absence of forests. All air-currents blowing from the sea are year by year charged with the same amount of moisture, which precipitates as soon as the air is cooled below the point of saturation. If such precipitation be caused by forests, the air currents reach the regions behind these forests drier and unable to yield a further supply of water.”

It is thus Oskar Peschel teaches in his well-known work “*Neue Probleme der vergleichenden Erdkunde*”; but he entirely omits from his calculation re-evaporation of moisture precipitated on the land, and his conclusions cannot consequently be accepted. A well-wooded forest area may best be compared to a landlord who spends his income derived from the country within it and for the benefit of his neighbours, whereas cleared areas resemble absentee proprietors who scatter their revenues in foreign parts. It rains; the drops are scattered on the

leaves, and fall in a soft gentle spray or in slow falling big drops, which have collected on the foliage, on to the spongy forest ground. The water has thus time to percolate slowly into the soil below, whence a large quantity is gradually pumped up again through the roots of the forest trees, exhaled by their leaves and again assists in forming rain-clouds. Wooded areas, no doubt, extract under the same circumstances more moisture out of the air than disforested regions; but they serve as a store-house and yield again what they take; whereas a great portion of the water precipitated on barren soil is only recovered by evaporation from rivers, lakes, and oceans. Forests use, therefore, much less moisture than barren areas in the same position and under similar conditions, and augment the atmospheric moisture in regard to regions which are separated by such forests from the sea, instead of diminishing it. Their action in this respect is not the same as that of an intervening mountain range.

In Assam, which is a broad, isolated, well-wooded valley, rain-clouds form in the winter, and it rains when no air currents reach it from the sea. The clouds are home-born and are, to some extent at least, due to re-evaporation from the vast forest areas still in existence. The same laws naturally apply to any locality, though they may not be so strikingly exemplified.

It may be argued that evaporation from open ground is much more intense than from soil covered by forests. No doubt this is the case; and Ebermayer in his "*Die Physikalischen Einwirkungen des Waldes auf Luft und Boden*" gives the following data:—

"The forest alone, without the cover of dead leaves, diminishes the evaporation by 62 per cent., as compared with that in the open. Evaporation is consequently 2.6 times less in the forests. A covering of dead leaves and vegetable mould diminishes evaporation by a further 22 per cent.

"Forests with an undisturbed covering of dead leaves and vegetable mould lessen the evaporation as compared with that in the open by 84 per cent."

These data are based on observations made in Bavaria during the summer months. In the Indian climate the difference, which increases in proportion to the heat and dryness of the atmosphere, would be even more considerable.

The above data refer to the evaporation from the soil, which, of course, can only take place as long as there is water on the surface, which in the open is not the case for long, as it either flows off or gravitates out of reach of the influence of evaporation. In a forest the water does not flow off with the same rapidity, and much of that which gravitates into the soil is pumped back by the long roots of the forest trees, and, especially during the period of vegetation, is exhaled by the leaves in quantities which represent far more than the moisture

evaporated from the open ground. There can be no doubt, whatever may be said to the contrary, that the widely-spread notion that forests tend to increase the rainfall, and that in a warm-climate the denudation of a country diminishes its moisture and consequently its fertility, is correct. As already pointed out, the theory is proved by history and ruins ; and the rapidity with which changes in the climate of different countries have taken place entirely forbids that such sudden modifications should be ascribed to cosmic causes. We accept other scientific problems on much more flimsy evidence ; but in this instance a large number of us suddenly swerve aside and follow a school which starts new theories on partial observations and leaves re-evaporation out of consideration. Ebermayer found, from experiments made, that during July, the hottest month in Bavaria, only 6 per cent. of the rain which fell percolated 2 feet deep into the ground in the open, against 61 per cent. which filtered down to the same depth in a forest, the ground of which was covered with complete and undisturbed vegetable mould.

In the one case, the water rapidly runs off into streams and seas by sudden floods and freshets, and this too when the whole atmosphere is surcharged with moisture. In the other instance, the water is stored for re-evaporation through the foliage of the forests, and is given forth at a time when the air is drier and the

winds do not blow from the sea. It may be safely stated that more than half the rain which is thus stored in the ground is re-evaporated by the trees in time of need; and even at this low computation, a well-stocked, well-protected forest area, the vegetable mould of which is undisturbed by either fire, or the axe or rake of the "*rab*" * or "*sur*" collector, would re-supply to the atmosphere at least one-third of the moisture which is precipitated on it. This would be available for the open country. If therefore 30 per cent. of the country was under complete forest, the rainfall throughout should increase by 10 per cent., under conditions similar to those which exist in Bavaria in July.

In India, or any other country with such a fierce climate as ours, the influence should be more marked.

The monsoons in India, it is argued, must be quite independent of forest growth. Quite so! Forests can have no influence whatever on the amount of moisture drawn from the ocean, and the general direction of the winds is unquestionably governed by greater causes; but, apart from this, periodical rains are subject to the same general laws as all other rains, and must, therefore, be affected by the same causes, and amongst them by extensive forest growth, in exactly the same way and degree. The air

* *Rab*—lopping of branches for manure.

Sur—collecting of fallen leaves for manure.

may be charged with moisture, which need not, however, be precipitated. If an extensive snow-fall in the outer Himalayas can affect the monsoon rainfall, it seems certain that forests can do the same, though probably not to the same degree.

With regard to the actual decrease of rainfall consequent on the destruction of forests, Major-General Fisher, R.E., an old resident of Bellary and Ramandrug, supplies the most interesting information in the following note:—

“I arrived in the Bellary District in June 1856 and visited the Ramandrug at once; the hills were then covered with a good strong jungle; there was always a heavy cloud during the night resting on the hills and for the greater part of the day: rain fell during the south-west monsoon constantly and frequently; during the north-east monsoon it was much lighter; in the months of March, April and May, the mango showers were usually very heavy and accompanied with much thunder and lightning. The average rainfall we calculated was then 45 inches in the year; all the springs about the hills ran abundantly throughout the year, and the Nareehulla, the main feeder of the Daroojee tank, with all its tributaries, had water running in them all through the year. The climate of the Drug during the monsoons and the cold weather was quite cold enough to make fires very necessary, although its elevation is not more than 3,300 feet above sea-level. The water-supply was most abundant during the whole of the hot weather, and the tank was almost always full, surplusing very largely during the south-west monsoon.

These observations refer to the years 1856 up to 1864 inclusive, when I left the Bellary District and did not visit the Drug again till January 1879. I found everything changed; the jungle has been almost entirely destroyed;

the rainfall is most precarious, and certainly not so much as 24 inches in the year ; the tank has not filled for the last three years, and is generally 10 or 12 feet below full tank level ; the springs are almost always dry, dribbling only at the best ; the climate is so changed that in the cold weather it is hardly necessary to shut the doors and windows ; except for the high wind and slight mists of the south-west monsoon, it would not be necessary to close the house at all. The main feeder of the Darojee tank dries up altogether by the end of February, and all its tributaries have no water in them."

Mr. Macartney, the Agent of the Sandur State in the Bellary District, Madras Presidency, also maintains that the rainfall within the last ten years has become lighter and more irregular with the increased destruction of forests by wood-cutters and charcoal-burners, and the indiscriminate grazing of cattle, sheep and goats. Mr. Macartney speaks from an experience extending over 22 years, and supports his observations by the following facts :—

" In the first decade of my residence here, the tank near my house used to be regularly filled every year and to be running over for several weeks at a time. Latterly, though, it has accumulated an immense amount of silt, and is now consequently of diminished capacity ; it rarely fills. The same remarks apply equally to the Ramandrúg tank and to that of Singankeni."

The Rushikulya, a river in the Ganjam District, Madras Presidency, is formed by two main branches. One of these, coming from the well-wooded hills of Surada and Pandakol, carries water for nine or ten months in the year ; whereas the other, the Mahanadi, taking

its rise in the much more open country of Gumsur and Chokapad, is dry for nearly eight months.

A difference of 10 per cent. in the average rainfall, combined with a more equal distribution, especially over the drier months, would suffice to bring about the historical changes already noted.

Ebermayer's exhaustive experiments have shown that the mean annual temperature in a closed forest is 10 per cent. less than in the open. In both cases the measurements were taken at 5 feet from the ground. The difference is greatest in summer, and, consequently, to us in India of much greater importance than to the inhabitants of more northern latitudes.

That when a much greater part of India was covered with forests the climate of the country was on this account different seems equally indisputable. Fa-Hsian, the great Chinese traveller in India in the 4th century (A.D.), says, in describing the country, that its temperature was neither cold nor hot. This, as already stated, is corroborated by the ruins of an old civilization in many localities where this could not now exist without large works of artificial irrigation. It may, I think, be assumed that the same state of things would re-establish itself if a considerable proportion of the country were again brought under dense forests, which is physically possible; but that this could be effected to the extent

desirable by any measures of forest conservancy that any Government could under existing circumstances apply, is out of the question. As this aim cannot therefore in practice be reached, the foregoing paragraphs might be branded as fanciful and useless; but if it once be accepted that the climate of India would regain its pristine state by a complete afforestation of a large proportion of the country, every step in that direction must exercise a small advance (however immeasurable) in that direction.

During the earlier period of the present administration, shifting cultivation (*kumri*) was practised to a large extent in the Central Provinces, and several thousand of square miles were thereby laid barren year after year. Early in the seventies this method of cultivation was stopped and extensive growth of young forests sprang up in its place. It is true the whole area is grazed over to a considerable extent and cannot therefore exercise that influence which it would exert under more favourable conditions, but it would appear that the influence has nevertheless been beneficial.

There is no divergence of opinion regarding the more local effects of forests in protecting the soil and regulating both surface and sub-soil drainage. In an open country the greater portion of the rain water runs off, and on a steep decline with great rapidity and force, carrying

Local influence of forests on the fertility of the country.

the fertile soil along with it and cutting deep ravines and gorges.

As long as the water carries fertile soil, the underlying country is often benefited by inundation, especially if this happens during the right time of the year. Soon, however, it is found that the good surface soil has disappeared, and the rushing torrents carry unproductive sand, stones, or clay, and smiling fields are covered with layers of dead soil unfit to produce a crop for years. The blessing of the proximity of chains of hills and mountains is turned into a curse, and in most instances by man's own action.

Almost every book treating of this subject teems with examples regarding the baneful results of deforestation which might be cited ; but we need not go to books, for Nature's own proofs are plentiful in this country.

The Hoshiarpur chôs, situated in a rich agricultural country in the north of India, are—owing to the fact that the hills from which they spring are to a great extent composed of very friable and sterile sandstone—one of the most marked examples of the injury which may result from the denudation caused by the destruction of forest growth. Year by year considerable additional areas are covered by unproductive sand, causing an incalculable loss to the country, which may be gauged by the fact that the loss in land-revenue alone since the last settlement was made is said to amount to R90,000 per annum. Sufficient proof exists that the hills

in question were once densely wooded, and that the destructive torrents did not then exist. Afforestation would cure the evil and form a monument to Indian forestry that could not easily be equalled.

The hill range between Mahasu and Fagu, in the vicinity of Simla, well known to all residents, was, as late as 1868, covered by a magnificent forest of Spruce, Silver-Fir, Blue-Pine, Deodar and Oaks. The ground was subsequently cleared for potato fields, and some fine crops of excellent potatoes were gathered. Now, however, the soil has been washed down into the ravines, the fields have to a great extent disappeared, and the barren hillside is cut up by the dry stony beds of Alpine torrents. These are but a few of the many examples in the Himalayas and sub-Himalayas where cause and effect may both be traced within the time of our occupation of India. Results of former and more ancient causes are discernible wherever the eye is cast.

Proofs of the lamentable consequences of deforestation in other parts of India are not wanting.

Denudation in the Ceded Districts of the Madras Presidency yearly covers with sand fresh areas of formerly culturable land. Even in the comparatively well-wooded valley of Pullampet, Cuddapah District, the consequences of denudation (due to indiscriminate cutting and overgrazing) are becoming very marked.

In Kanara numerous instances are reported where spice gardens near the Ghâts have had to be abandoned on account of the destruction of the forests in the vicinity, and even within the once moist and cool valleys of the Sirsi and Siddapur ranges, gardens were deserted soon after the hillsides had been cleared of forest growth.

Similar observations have been made in Assam, where the surface-soil in many tea-gardens has been washed away, and where the yield has consequently dwindled down to next to nothing.

The Ratnagiri District, in the Bombay Presidency, is almost bare up to the crest of the Ghâts, and here, Sir Dietrich Brandis says, the effects of denudation have shown themselves in this way :—

“ There are four principal streams in the district, which, rising in the Ghât mountains, run a short course to the sea, all of which were formerly navigable and important for the trade of the country. For small boats they are still navigable, but they are gradually silting up because the hills at their head-waters have become denuded of forests.”

The slopes on the west coast of the Bombay Presidency were once, even during the earlier days of British occupation, clad with magnificent and most valuable and extensive Teak forests ; but these have long since disappeared.

The denudation of the Deccan highlands and the Eastern Ghâts has resulted in the gradual silting up of rivers. When the English, French

and Dutch first made settlements on the Coromandel Coast, they were able to take ships up the rivers Godavari and Kistna. Narasapur (English) and Yanaon (French) on the Godavari, though now only approachable by small native crafts at high tide, were once the chief ports for that part of the coast. At Masulipatam the Dutch ships used to come close up to the fort, but now even native vessels of small draught have to anchor 5 miles out in the roads.

It is also said that a hundred years ago, when the Ganjam town and fort were places of considerable importance on the Madras coast, small sea-going vessels used to cross the bar of the river and lie at anchor opposite the fort — a place where there is now barely 2 feet of water in the dry season. Dr. Gibson, the first Conservator of Forests in the Bombay Presidency (1847), gives, in one of his earlier reports, a list of creeks and rivers on the Malabar Coast where ships used to ride at anchor, and which had silted up within the memory of men then living. Lake Fife, near Poona, in the Bombay Presidency, the catchment area of which is greatly denuded, is, it is believed, rapidly silting up. The cost of this magnificent work was £1,000,000.

The increased suddenness and violence of floods in hill-streams, as an immediate consequence of the destruction of forests on their catchment areas, have been noticed in many parts of the country. The most remarkable

observations in this respect have been made by the officers on the Jumna Canal, with regard to the streams opening into this waterway. From the Cuddapah District, in the Madras Presidency, similar reports have been received, and it is stated that the floods in the Gandaleru, Ganjana, and Moshtiyem hill-streams, which take their rise in the Seshachellam hills, have increased in suddenness and violence since the density of the forests on their catchment areas has decreased.

The periodically recurring breaches in the railway embankments, especially those of July 1866, are, there is good reason to believe, due to the denudation of the Sewaliks and other sub-Himalayan hills.

In the same way as the hurtful effect of deforestation on soil and drainage is chiefly felt when the ground is hilly and in a degree proportionate to its steepness, the beneficial effect of the action of forests in this respect is greatest under similar circumstances. It would again be easy to quote numerous examples based on observations made in other countries, and it would be more excusable, as results due to strict conservancy are much rarer in India than warning examples; for only completely stocked forests which are free from conflagration, and the ground of which is covered with dead leaves, twigs and vegetable mould, have an appreciable effect as regards protection of the soil and regulation of sub-soil drainage.

Open forests, in which the grass and vegetable debris are consumed by annual fires, or from which the mould and dead leaves and twigs are constantly removed by “*sur*” or “*rab*” collectors, have no effect in this respect.

In Chamba, Kulu, Bashahr, and in the immediate vicinity of Simla, the results of strict conservancy in protecting the soil and in regulating the water-supply are clearly discernible to every one who has re-visited these localities after an absence of ten or twelve years; but these observations are perhaps too general to carry conviction.

The beneficial effect of forests properly protected was, however, very marked in the following case. In 1878 a road was built from Ellichpur in Berar into the heart of the Melghat forests, which had been protected against fire for ten years, and had consequently become in most parts completely stocked with a heavy layer of old leaves and grass on the ground. The road runs partly through the forest thus protected and partly through the open or unreserved forests, where no protection had been attempted, and the Executive Engineer who constructed the road wrote as follows regarding the effect of protection upon floods in that part of the country:—

“During the late heavy rain, *viz.* 4 inches in 24 hours in the beginning of June 1897, I had four bridges in construction in the Bairagarh Reserve on the Ellichpur-Pili road, *viz.* Nos. 18, 19, 22, and 23. The foundations

of these bridges were not finished, and I expected much damage to them by the early rains. Much to my surprise I found that when the rain was finished none of the *nalas* over which these bridges are being constructed had been in flood, and no damage had been done to the foundations. In the unreserved forests, between Sirasban and Ellichpur, all the *nalas* had been in flood, and I attribute the escape of the foundations of the bridges in the reserve to the rain having been absorbed by the old fallen leaves and grass, thus showing the protective power of forests to bridges in preventing sudden heavy floods."

Interesting observations regarding the appearance and disappearance of springs, following in the wake of protection or disafforestation, have been made by Babu Ladha Singh, late Extra-Assistant Conservator of Forests in the Punjab, and are illustrated by maps.

In the Trichinopoly District, Madras Presidency, considerable planting operations have been carried on during the past ten or twelve years along the banks of the Cauvery. Observations prove that whereas wells from 6 to 10 feet deep in the plantations are well supplied with water throughout the hot weather, even when the river and neighbouring channels are quite dry, wells 15 feet deep on unplanted land in the neighbourhood, on the same level and otherwise similarly situated, are quite dry throughout the hot months.

The influence forests exercise in controlling and regulating the water-supply, especially in hilly countries, is not only recognised throughout the scientific world, but acted up to; and

especially in France large sums of money are spent and much energy and ability are brought to bear upon the question in re-afforesting of the Alps and the Pyrenees.

The question is of even greater importance for India than in Europe, and no better arguments with regard to this can be brought forward than those used by Sir Dietrich Brandis in his pamphlet entitled "Progress of Forestry in India."

"In a large portion of India the crops depend either partially or wholly upon irrigation, and the water is derived from tanks, wells, or rivers. The tanks are water reservoirs of various extent, generally constructed by damming up a stream or river in a convenient place; but there are also smaller storage tanks, which are fed only by the surface drainage flowing direct from the catchment area. Tanks of this latter description would store the largest proportion possible of the water coming from the catchment area, if that area were made impermeable to the rain which falls upon it. In such cases trees and forests upon the catchment area are injurious, and several instances have been observed where such tanks have ceased to be filled since the forest on their catchment area has become dense and heavy. It is different with the larger tanks, which are fed by springs and streams. These benefit largely by thick forest growth upon their catchment area. The area irrigated from wells in the different parts of India is very large. Thus, in the Madras Presidency two million acres are irrigated from wells, while three million acres are irrigated from rivers and tanks. There is no reason to believe that forest growth on level ground has the effect of raising the sub-soil water level, which is tapped by the wells; but wells are frequently dug at the bottom of a valley or near the bed of a stream, and in such places

there is ground for believing that the underground water stratum which is tapped by the wells will be supplied more plentifully, and that the supply will be maintained longer during the dry season if the hills which surround the valley are clothed with dense forest growth. Wells of this description are numerous in Ajmer and Merwara and one of the objects for forming the forest reserves in those districts was to improve the water-supply in these wells.

The Indian rivers which feed the canals used for irrigation are of two classes. The Ganges and Indus, and their tributaries, are fed by the snow which falls on the Himalaya mountains and by the plentiful summer rains of the monsoon. The water-supply of these large rivers cannot materially be affected by the small forest area which it may be possible to place under good management on those mountains, but between these big streams a large number of smaller rivers exist, the drainage area of which is situated in the lower hills and which join the main streams below their debouchment from the mountainous region. Of the other rivers which are used for irrigation, the most important are the Sone in Bengal, the Mahanadi in Orissa, and the Godavari, Kistna and Cauvery in the Madras Presidency. These rivers and their feeders rise in the hills of Southern and Central India, which derive their water-supply chiefly from the summer rains of the south-west monsoon. In regard to these rivers there is good ground for believing that their water-supply is largely affected by the forest growth upon their catchment area, and that in some cases denudation has already done great damage in this respect.

The Tambraparni, in the Tinnevely District, is one of the smaller rivers used for irrigation in India. Its catchment area is 1,739 square miles, of which 1,389 are in the plains and 350 square miles in the hills on the eastern slopes of the Ghâts. This river irrigates the large area of 170,000 acres or 265 square miles, of rice-fields, more than one-third of which bears two crops. It

is a beautiful sight to see this large expanse of brilliantly green fields at a time when the country around is parched and barren. This river carries down into the plains a very large proportion of the rain which falls upon its catchment area, and there is good ground for believing that if the forests, which fortunately are dense and extensive near its head waters, were cleared, a larger proportion of the rain water would be lost by evaporation, and that the supply, which now flows almost uniformly during the greater part of the year, would come down in sudden rushes after each heavy fall of rain, and would be more irregular.

The necessity of a vigorous forest policy was thus strongly indicated from the earliest days of British occupation of India, but it was not understood; and questions which were considered of more immediate importance pressed its claim into the back-ground.

Our earlier administrators, occupied with the building up of an Empire, probably never thought of the important part forests have always played, play now, and will for ever play in the household of nature, or of the immense influence they exercise on the physical well-being of a country; while as a necessity for the people, and as a revenue-yielding property, they were considered insignificant. Only under exceptional circumstances could their produce be transformed into money. The people took all that they required for their simple wants where they found it. Trade in forest produce and wood-consuming industries were in their infancy, and for a considerable time the demands of the Government and of the country

*Early Forest policy
after British occu-
pation.*

generally were met without difficulty. This being the case, no doubts crossed the minds of our earlier administrators, but that this state of things could and would continue for ever, no apprehension was felt that the supply of forest produce would ever fall short of the demand, and forests were considered as an obstruction to agriculture rather than otherwise, and consequently a bar to the prosperity of the Empire. It was the watchword of the time to bring everywhere more extensive forest areas under cultivation, and the whole policy tended in that direction. The direct and indirect value of forest was under-estimated, as is clearly exhibited by the provisions of many of the earlier settlements, especially in Bengal and the Punjab, which transferred large forest areas for ever to landholders or to the cultivators of the country, who at that period had neither a right to them nor in many instances even appreciated the boon granted to them, as they valued the areas as little as the Government which gave them. In the Central Provinces, efforts—which however, in most instances, luckily failed—were made after the last settlement to sell outright all Government forests, except a few to be reserved for the production of timber for Public works. Frequently, when the forests were not entirely alienated, the main rights of user, which constitute the value of the possession of forests, were abandoned in favour of the cultivator.

This was naturally a transitory state, for, with the advance of modern civilization, the demands both of the trade and of the population increased, whereas the forests diminished in size. Railways spread and forest growth disappeared with an incredible rapidity within reach of the lines, partly on account of the direct demands made on them for constructive works and fuel—demands which were frequently met by an exploitation carried on in a reckless and wasteful manner—and partly on account of the increased impetus given to cultivation. Flocks and herds, moreover, multiplied more rapidly on account of the security afforded under a settled Government, and in consequence of the higher prices that could be realized for cattle; and whilst, on the one hand, civilisation thus made daily increasing demands for forest produce, a great part of India's population was (and is) weaned only with the greatest difficulty from their pastoral, semi-nomadic habits, and wasteful methods of cultivation, as practised by savage and early settlers. The concomitants of both the nomad and the backwoods cultivator are forest fires, and our Indian forests were thus exposed at the same time to the legitimate demands of a rapidly spreading modern civilisation, and the waste which accompanies a more primitive state of society. The true state of affairs was not, however, recognized until local wants, and failures to supply them, were felt. This happened

comparatively early, mainly with regard to timber for ship-building ; but in most instances the solution of the difficulties encountered was sought for in improved methods of exploitation both by direct Government agencies or through contractors and lessees, and even when protection was accorded, this was for many years not extended to the forests as a defined organism in the household of Nature, but merely to a few marketable species.

It would be futile and of no special interest to follow up the various efforts made in this direction in great detail. The earliest record of these attempts is the formation of a timber syndicate in Malabar in 1796, with Mr. Machnochie of the Medical Service as the leading spirit. Some time later this syndicate collapsed, but other agencies, purely connected with the supply of timber for the navy, were opened, closed and re-opened from time to time.

The early history of the Tenasserim forests shows similar features, though to a somewhat lesser degree, resulting, however, in leases for a long period, which were till quite recently a thorn in the side of the present administration, especially as the conditions thereof did not sufficiently safeguard the future of the forests. Similar attempts to provide supplies solely by improved methods of extraction grew up in other provinces and, under the impetus given by railway construction, continued to within comparatively recent periods.

Such efforts naturally did not improve matters, and led to the ruin of much valuable forests, especially in the vicinity of floating streams, or near other means of communication. But even during the earlier period some far-seeing people existed who foresaw that the then existing state of things could not go on. A feeling of unrest sprang up and it was felt that something must be done to prevent an ultimate drying up of supplies. The see-saw of action and re-action which took place in consequence is an interesting study, and though the main-spring of movement was merely the maintenance of the supply of certain species of timber (at the outset of Teak only), and not the physical advantages derivable from forest conservancy; and though, as at present, an incredible amount of ignorance and vacillation was displayed occasionally and but few permanent results were achieved, the fact remains that this period forms the approach, uneven and disconnected though it may be, to our present system of forest conservancy.

During the earliest days of British occupation, the Teak forests of Malabar were regarded as private property, but it was soon ascertained that Tippoo Sahib, during his dominion, had regarded the Teak as a royal tree; and as the same royal right in these trees existed in the neighbouring States of Cochin and Travancore, this view of the case was adopted.

The first step towards forest conservancy was

*First attempts at
Forest administration.*

an order issued by the Bengal-Bombay Joint Commission, appointed to enquire into the internal circumstances of Malabar and to make regulations prohibiting the felling of Teak below 21 inches in girth. Nothing further happened till 1805, when a despatch was received from the Court of Directors, enquiring to what extent the King's Navy might, in view of the growing deficiency of Oak in England, depend on a permanent supply of Teak timber from Malabar. This enquiry resulted in the immediate appointment of a forest committee, charged with a very comprehensive programme of enquiry regarding not merely the forests but the status of the proprietary rights in them. The reports submitted showed that the capacity of the forests in mature timber had been over-rated, that the nearer forests had been almost cut out, and that it would entail the construction of costly roads to exploit the more distant parts; but that protection would result in the gradual formation of a valuable property. The immediate result was a general proclamation, declaring that the royalty right in Teak trees claimed by former Governments was vested in the Company, and prohibiting all further unauthorised felling of such trees. Under further pressure of the Home Government, and with regard to future strength of the King's Navy, it was decided to appoint a special officer acquainted with the language and habits of the people and having a knowledge of forests,

with a view to the preservation and improved production of Teak and other timbers suitable for ship-building.

Thus, Captain Watson of the Police was on the 10th November 1806 appointed the first Conservator of Forests in India. He had great powers given to him under the proclamation of April 1807, which was, to say the least, somewhat vague both as regards scope and extent of interference contemplated, and he used them with great energy and less discretion. Within a couple of years he had succeeded in establishing a timber monopoly throughout Malabar-Travancore, and practically annihilated more or less all private rights in the forests by assuming their non-existence.

The Government had a plentiful and cheap timber supply during his reign and that of his immediate successors, and matters were allowed to drift. However, the general discontent excited amongst proprietors as well as traders rose to such a pitch that on the recommendation of the then Governor of Madras (Sir Thomas Munro), and after consideration by the Supreme Government, the Conservatorship was abolished in 1823.

From 1806 to 1823, though apparently nothing was done for their regeneration, the Malabar forests had received some sort of protection by means of this probably unjustifiable monopoly, but subsequently a terrible reaction set in, and the benefits which had

accrued to the forests were annihilated. The landholders re-occupied the forests, to many of which they had apparently no better claim than that they took possession thereof during the first days of the reign of the Company.*

* How shadowy these claims frequently were is fully evidenced by the well known Kanara case (Indian Law Reports, Bombay series, Volume III of 1879, Appellate, Civil, pages 452 to 785), a case which should be read by every Forest and Forest Settlement Officer.

Even the entirely undisputed Government forests were during this period visited by almost unrestricted fellings, encouraged, rather than

restricted, by one of those timber agencies mentioned on a previous page, who under the supervision of an officer of the Indian Navy made large advances for timber to native contractors. The natural consequence was that large forest areas were entirely lost to Government never to be recovered, others were ruined, and many of those at the water's edge were devastated for good and all. The consequence of such reckless working was that within a few years the available supply of really first-class timber contracted and the prices rose. As early as 1831 the Indian Navy Board recommended the re-establishment of the Conservatorship. The Madras Board of Revenue was consulted, and on being reminded in 1837, when a report was received about the miserable state of the Travancore forests, promised to formulate their proposals.

In 1838, when submitting various reports

from Collectors containing more or less practical proposals, they merely suggested that interference, if at all necessary for the conservation of Teak forests, should be exercised by the Revenue officer and not by an independent authority, and that the former might be authorised to take steps to prevent the cutting of small timber and under-sized trees.

On receipt of this, the question was next referred to the Madras Military Board for an expression of their opinion. Many more or less valuable reports were written, but no practical results were achieved for years. As late as 1842 the Court of Directors considered that some Teak plantations of limited extent might be established to safeguard the future, and that the present supply could best be arranged under contracts. In support of this view they referred to the success of this latter measure in the Tenasserim forests, losing sight of the fact that the operations in this province were still backed by large forest tracts containing still larger quantities of full-sized trees. I cannot leave these old records without mentioning Mr. Conolly, who was during part of this period Collector of Malabar. This officer did yeoman's service in the interest of forestry. He urged his views again and again, succeeded in creating a small local Forest Department, costing R314-8 per mensem, framed some simple local rules, and in 1842, in order to provide timber for his district when the forest which he saw

rapidly disappearing should be exhausted, he laid the foundation of the now famous and valuable Nilambur plantation. Though the necessity of scientific advice was beginning to be more constantly urged, it was not till 1847 that the Bombay Government appointed Dr. Gibson as Conservator of Forests, after he had served for some years as interim Conservator in addition to his duties in connection with the botanical gardens.

Madras followed suit some years later, and in 1856 appointed Dr. Cleghorn to be Conservator of Forests in that presidency. Both these officers signalled their appointment by some valuable reports, in which the physical value of the forests was for the first time taken into consideration. Dr. Gibson showed that the wholesale destruction of the forests which had taken place during preceding years by overfelling, but above all by the rapid increase of shifting cultivation, had led to the silting up of rivers, which thirty years previously had been known to be free. Dr. Cleghorn's early reports and letters move much on the the same line, and both officers strongly advocated that Government should claim and exercise the proprietary right to all such forests as could not be clearly proved to be private property, a stricter conservative control, and above all an immediate restriction of shifting cultivation in the hills.

The seriousness of the situation was not, however, recognized and none of the steps recom-

mended by them took effect till much later, and forest conservancy in those provinces hardly rose above the level of a revenue administration. As a matter of fact hardly anybody believed in the possibility of a conservative treatment of State forest property through a State department ever being remunerative.

In the Tenasserim forests, as in the whole of Burma, the Teak was a royal tree long before the British occupation of any portion of the kingdom. This was an indisputable fact and rendered matters much easier than on the west coast of India. From the very outset there was a considerable consumption in the harbours of Burma, and the interest of the Government was awakened at an early period.

In 1827, Dr. Wallich was deputed to examine the forest resources of the country and declared them to be unrivalled when compared with those in any of the other possessions of the East India Company. He warned the Government, however, not to consider them inexhaustible, and pointed out that ample though they were, they would disappear under the steady increasing demands for Teak, unless placed under systematic and conservative management. "Unless the principle be acted upon from the very outset," he writes, "I will venture to predict that private enterprise will very soon render fruitless all endeavours to perpetuate the supplies for the public services, and one of the principal and most certain sources of

revenue of this Province will thus be irrevocably lost." Unfortunately Dr. Wallich appears to have had but hazy ideas of the principles of silviculture and forest organization, and recorded some very questionable opinions on both points, advocating not merely the forestalling of the possibility of the forests, but ignoring the silvicultural requirements of Teak by saying that it would be proper to cut down all the full-sized Teak as soon as this could possibly be done, in order to speedily realize a large consignment of valuable timber and to afford room for supplying fresh additions to the number of trees in the forests. This was wrong, even though he qualified his opinion by recommending fire protection, the removal of trees of inferior species, and the protection of sound, young and under-sized Teak.

Dr. Wallich's advice was but partially accepted. As a large number of full-sized trees were in evidence, the forests were thrown open to speculators in 1829, who paid an *ad valorem* duty on the timber extracted. They were not otherwise interfered with, and fire-protection was not introduced. Though as late as 1842 the Court of Directors still quoted the excellence of these arrangements and recommended similar ones for Malabar, anxiety as to the future of the forests began to be felt locally in 1837, and Dr. Helfer, who was deputed to examine them, found a great absence of young growth and recommended the establishment of

extensive plantations. A further period of inaction followed on the part of the authorities, but not on that of the private exploiters.

In 1841 it was proposed that all old leases and contracts should be cancelled and new agreements, containing suitable conditions by which it was intended to safeguard the future of the forests, should be issued.

This proposal met with considerable opposition, and pressure was even brought to bear on the Court of Directors. However, the measure was ultimately carried, and leases were granted under the new conditions, the principal one of which was the planting of five seedlings for every Teak tree felled, and secondly, the power of cancellation in case any of the conditions remained unfulfilled. This power was in some instances put into effect, but as fire-protection was not one of the conditions, it was impossible to control the planting of saplings, even had means of control existed, which was not the case. It is true Mr. Colvin, the then Commissioner, organized a small Forest Department in 1847, but it was quite inadequate to cope with the business, and matters were otherwise allowed to remain as they were.

In 1852 the Province of Pegu was annexed. For nearly a hundred years Teak timber had been one of the staple exports from Rangoon and the forests had been claimed as royal property by the Alompra dynasty. Following this precedent all forests were declared to be

*The dawn of
Forestry in India.*

Government property almost immediately after the annexation, and Dr. McClelland was appointed Superintendent thereof. Although the forests were the undisputed property of Government, their spoliation and development, as development is understood by the merchants sharing in the scramble and profits, began on much the same lines as had been witnessed in Southern India and Tenasserim. In 1854 Dr. McClelland, who for months had been travelling in the forests, submitted a report in which he proposed certain curtailments to the exploitation by private parties.

This report evoked a memorable reply by the Government of India, dated 3rd August 1855, in which Lord Dalhousie laid down, for the first time, the outline of a permanent policy for forest administration.

This was a great step in advance, and the man to carry out such policy in the face of the most strenuous opposition was found in Mr. Dietrich Brandis, who was appointed in January 1856 Superintendent of Forests in Pegu. With this appointment, the dawn of scientific forestry in India began. In 1857, the forests of Tenasserim and Martaban were added to his charge. It became at once evident that a master-hand and mind had got hold of the rudder. It would lead me too far to follow Mr. Brandis through the next five years of incessant work and struggle. A worthy record of this can be found in the "*Indian Forester*"

of August 1884. He introduced from the outset principles of enumeration and organization of the working of the forests, which still form the basis of our working-plans, as well as the system of native contractors, which in its present development enables us to take the exploitation of the vast forest areas of Burma into our own hands, or at least to enforce suitable conditions and prices from private timber firms. In fact he created a practical system for the working of the forests under his charge.

He also introduced measures for the protection and improvement of the forests, and correctly foresaw that if the people of the country could ever be brought to plant Teak in their shifting cultivation, this would be likely to become the most efficient mode of artificially reproducing the tree. He left before practical effect could be given to this, and the idea lay fallow for many years afterwards, but the prophecy has become true nevertheless.

Those mercantile firms in Burma, who, apart from paying a very low duty, had had the free run of the Government forests were naturally indisposed to accept this position and to see this source of revenue closed to them by the strength of a single man, and in 1860 to 1862 a combination of merchants pressed once more for the general introduction of exploitation by private enterprise. Mr. Brandis was attacked from all sides, and after a long struggle he had

to give way, at least partially, under direct orders from Calcutta, to which place the field of strife had been removed. The greater portion of the Pegu forests was thrown open to lessees, but the selection of the trees to be felled and their girdling was placed under the control of the Forest Department, and more practical and stringent conditions than those which only nominally safeguarded the previous exploitation leases and permits were introduced. Moreover, the Tharrawaddy forests remained unconditionally subject to departmental exploitation and were worked as they are now by departmental contractors. This was lucky, for, as years went on, this retention proved the correctness of Mr. Brandis' views; for whereas the State incurred heavy financial losses—probably far above R1,00,00,000—by private exploitation of the forests thrown open to private enterprise, the Tharrawaddy forests soon became and have remained up to date a source of a large regular income. The selection by the Forest Department of trees to be exploited curtailed the number annually girdled to the permanent annual production of each forest, whereas the merchants were anxious to remove all saleable timber regardless of the future. In consequence one more determined attack was made on Mr. Brandis' policy in Burma, which was branded as destructive of all hope of making the forests of the Province a source of revenue to Government, a source of supply for

timber and an element of wealth and prosperity to the country. It was demanded that the lessees themselves should girdle all marketable timber and that the departmental girdling which Mr. Brandis had introduced should be abolished.

The utter fallacy of these proposals are now evident to every one, but at the time they were backed up by the Conservator of Forests and recommended by the Local Government. The struggle was a severe one, but Mr. Brandis gained the day. Had he not done so, the forests of Pegu would have been sacrificed, and it seems to me probable that the present resumé of the successful development of the Indian Forest Department could never have been written.

The forests in other provinces were used as the produce was needed, but no attempts were ever made to conserve and protect them, with the exception of those in the Punjab, where, under the far-seeing guidance of Mr. Richard Temple, the forest rules of 1855 and subsequent years were promulgated. In December 1862 Mr. Brandis was placed on special duty with the Government of India to assist in organizing forest administration in other provinces, and on the 1st April 1864 he was appointed the first Inspector-General of Forests to the Government of India. This was the break of day for forest administration in India, and our history dates from this period.

*Present Forest
administration and
its development.*

The new Department was, in the first instance, placed under the Secretary in the Public Works Department and in charge of the Honourable Member of that Department.

In 1871 it was made part of the business of the newly constituted Department of Revenue and Agriculture. On the abolishment of this Department in 1879 the forest business was transferred to the Home Department, but retransferred in 1886 to the Department of Revenue and Agriculture which had been re-formed in 1881. Ever since 1871 the Forest Department has been in charge of the Honourable Member holding the portfolio of the Home Department.

Mr. (now Sir) Dietrich Brandis was the first Inspector-General of Forests, and held this office from 1st April 1864 to 23rd April 1883. He was succeeded by Dr. W. Schlich, who retained the post till 31st December 1888, when he was succeeded by the writer, who is still in charge. However, Sir Dietrich Brandis was placed on special duty on the 16th October 1881, and Dr. Schlich, who acted in his place, had uninterrupted charge till 25th February 1885, when in his turn he was relieved by myself, and it will therefore be convenient to adopt the periods from 1864-65 to 1880-81, 1881-82 to 1884-85 and 1885-86 up to date.

During the first period, the following officers officiated as Inspector-General of Forests :—

Captain E. C. S. Williams, R.E., from 13th April 1865 to 7th May 1866; Dr. H. Cleghorn

from 7th May 1866 to 14th March 1867 ; Colonel G. F. Pearson, M.S.C., from 29th January 1871 to 29th December 1872 ; Mr. B. H. Baden-Powell, from 30th December 1872 to 8th April 1874. During the third period Colonel F. Bailey, R.E., officiated from 3rd August 1887 till 31st October 1887, and Mr. H. C. Hill from 7th August 1889 to 1st March 1891, from 22nd December 1893 to 21st March 1894, from 19th February 1895 to 1st April 1896, and from 8th July 1899 to 8th October 1899.

Once the necessity of an organised Forest Administration throughout the country had been recognised, the Government of India proceeded, with its customary energy, to create and develop a Forest Department for the great work before it. As already mentioned, Conservators of Forests had been appointed in Bombay in 1847, in Madras in 1856, and for the United Burma Provinces in 1857. The beginning of the organization of a Forest Department in the other Indian Provinces took place in the following order:—

North-Western Provinces—1860, under Commissioners; and in 1868 under a Conservator.

Central Provinces—1860.

Oudh—1861.

Punjab—1864.

Coorg—1864.

Bengal—1864.

Assam—1868.

*Organization of the
Forest Department
and its growth.*

Berar—1865, amalgamated with the Central Provinces ; and in 1868 as a separate charge.

As work increased, experience taught that several provinces were too large to remain in charge of one Conservator, and thus Bombay was divided into three Conservatorships in 1873 ; Assam was separated from Bengal in 1874 ; Burma was divided into two Conservatorships in 1876 : the North-Western Provinces and Oudh were formed into three Circles in 1878 ; and Madras was separated into a Northern and a Southern Circle in 1883.

Since then some further changes have taken place ; the Central Provinces were divided into two Circles in 1889. In 1886 two new Circles were added in Burma, owing to the conquest of Upper Burma. Madras was divided into three Circles in 1891 and Bombay into four in 1892. From the beginning it was recognized that the Forest Range must ultimately form the unit of forest administration ; but for many reasons it was quite impossible to enlist this agency before a controlling staff had been provided.

Even this took some time. No officers were available specially trained for the work, and the earlier appointments had to be filled by men selected from other branches of the Public services.

Officers were as a rule chosen who had previously shown qualifications for forest life and forest management. In some instances they were naturalists, in others sportsmen. Allowing,

however, even for such special selection, the aptitude with which the majority of these officers found themselves after a short time at home in their new sphere is astonishing and highly creditable, proving once again the special adaptability of the English race for administrative work of any kind. Many amongst those appointed without special previous training have left their permanent mark in the history of the progress of forest administration in India, and names such as those of Pearson, Doveton, Campbell-Walker, Bailey and Shuttleworth will long be remembered in the annals of the Department.

The first graded list of Conservators, Deputy and Assistant Conservators under the Government of India was published in 1869, when the staff consisted of 57 officers, costing Rs94,618 per annum.

Increased work and the growing requirements of the administration necessitated constant additions, and in 1882 the staff already consisted of 94 officers in the Controlling grades, costing Rs6,29,424 per annum. The decrease in the average monthly rate of pay, which was much too low from the outset, was mainly due to the appointment of many junior officers, without making the necessary provision for their advancement to higher grades. The consequence was stagnation in promotion and the natural accessory—dissatisfaction—amongst a deserving body of servants of the State, who

could barely hope to attain to the grade of Deputy Conservator on R500 per mensem under 12 to 15 years of service.

The Government of India recognized the hardships of the case, and with the previous sanction of Her Majesty's Secretary of State, the Department was reorganized on the 3rd September 1882 on the scale recommended by Dr. Schlich, then Conservator of Forests. The number of officers was raised from 94 to 100, and the average pay was fixed at R642 per mensem. The increase of the average in the Controlling Staff was caused by providing a more suitable proportion of appointments in the higher grades.

Soon after the reorganization had taken place, it was found necessary to add three officers in Burma and three in Assam, and one for Baluchistan. These appointments again caused a fall in the average pay, from R642 to R628 per mensem.

The Controlling Staff under the Government of India stood in 1885 as follows :—

Conservators of Forests (R1,000, 1,250, 1,500)	10
Deputy Conservators of Forests (R550, 650, 800, 900)	55
Assistant Conservators of Forests (R250, 350, 450)	38
Special appointments connected with the Forest School, Forest Surveys, and Working-Plans (R600 to 900)	4
TOTAL	107

The Forest officers serving in all provinces under the Government of India were originally borne on one list, and promotion was regulated accordingly. The injustice of this was soon apparent, as officers in the healthy hill climate of the North-Western Provinces and the Punjab benefited by the greater mortality in Burma and other hot-beds of fever, where the official existence of a Forest officer is naturally shorter. The Forest staff was therefore gradually localised, and was in 1885 distributed as follows:—

Provincial List.	Conservators.	Deputy Conservators.	Assistant Conservators.	TOTAL.
1. Bengal-Assam	2	...	9	22
2. North-Western Provinces and Oudh (with Ajmer) . . .	3	10	8	21
3. Punjab (with Baluchistan) . .	1	11	7	19
4. Central Provinces—Berar (with Coorg)	2	11	7	20
5. British Burma (with Andamans)	2	12	7	21
6. Special appointments . . .	...	4	...	4
TOTAL	10	59	38	107

The Controlling Staff in the Madras Presidency had, since the first organization of the Department, gradually expanded, and it consisted in December 1882 of 16 officers. At that time a revolution took place in the whole forest management of the Presidency, by the amalgamation of what was locally known as

the Jungle Conservancy Department with the Forest Department. This arrangement largely increased the requirements made on the Forest staff, and necessitated a considerable increase. A reorganization was consequently decided on, and a staff of 24 officers was sanctioned by Her Majesty's Secretary of State. Two more appointments were subsequently added, and the staff in 1885 stood as follows :—

Conservators of Forests . . . . .	.	.	.	2
Deputy Conservators of Forests . . . . .	.	.	.	14
Assistant Conservators of Forests . . . . .	.	.	.	10
TOTAL				26

The monthly average of pay was the same as in the Bengal Presidency, *viz.* R628.

The reorganization of the Bombay Controlling Staff took place in November 1883. The history is the same as that of the Bengal Presidency. The staff had gradually increased to 23 officers, and the average monthly pay had declined to R551.

The reorganization provided for 27 officers, with an average monthly pay of R635. The staff then stood as follows :—

Conservators of Forests . . . . .	.	.	.	3
Deputy Conservators of Forests . . . . .	.	.	.	14
Assistant Conservators of Forests . . . . .	.	.	.	10
TOTAL				27

To this, two more appointments were subsequently added to provide for the extension of working-plans, raising the total to 29.

To sum up, the Controlling Staff in the three Presidencies stood as follows in 1884:—

	Rates of Pay.		No. of Officers.
	R	R	
Inspector-General of Forests to the Government of India .	1,700	to 2,000	1
Conservators of Forests .	1,000	to 1,500	15
Deputy Conservators of Forests	550	to 900	85
Assistant „ „ .	250	to 450	58
Special appointments .	600	to 900	4
TOTAL			163

Further additions were made to the staff, and in 1888 the list stood as follows:—

	Rates of Pay.		No. of Officers.
	R	R	
Inspector-General of Forests to the Government of India .	2,000	to 2,500	1
Conservators of Forests .	1,100	to 1,600	18
Deputy Conservators of Forests	550	to 900	100
Assistant „ „ .	250	to 450	64
Special appointments .	600	to 900	2
TOTAL			185

The average pay for India had been maintained, but varied considerably in the several provinces. A reorganization was then proposed, but was not sanctioned until February 1891. Under this reorganization, the Imperial Service contained 196 officers on an average pay, including Conservators, of R676, excluding them of R607.

Under this reorganization, the pay of the Inspector-General of Forests having previously been raised from R1,700 to R2,000, to R2,000

to R2,500, that of Conservators was also enhanced from R1,000, R1,250 and R1,500 to R1,100, R1,350 and R1,600. Part of the scheme was that only 80 per cent. of the Controlling Staff should be in future recruited by the Secretary of State through Cooper's Hill College, and that the remaining 20 per cent. should be filled by the advancement of qualified and deserving men from the Lower Controlling Staff, the members of which were to be drawn from students of the Dehra Dun Forest School and the Poona College, who had passed through the lower grades of the service.

Thus the Provincial Forest Service, of which more hereafter, was created in contradistinction to the Imperial Forest Service, which it is intended shall form the élite.

In 1896 further additions were made to provide for the requirements of Burma, which had, owing to the recent conquest, not been fully ascertained.

Under this reorganization the service of Upper Control was increased to 211, and the average pay was maintained. The arrangement that 20 per cent. of the appointments of Deputy and Assistant Conservatorships should ultimately fall to the Provincial Service was adhered to.

The sanctioned list now stands as follows, and it has been decided that any future demands shall, as far as possible, be met by a direct increase in the upper grades of the Provincial

Service, for which an increasing number of officers become qualified year by year :—

	Rates of pay.		No. of Officers.
	R	R	
Inspector-General of Forests to the Government of India . . .	2,000	to 2,500	1
Conservators of Forests . . .	1,100	to 1,600	19
Deputy Conservators of Forests . . .	550	to 900	122
Assistant " " . . .	350	to 450	64
Special appointments . . .	<i>No fixed rates</i>		7
	TOTAL		213

In order to insure a more equal flow of promotion, the services of the Punjab, the Central Provinces, Coorg, Berar, and Baluchistan were amalgamated. The obligation to officer Coorg has, owing to language difficulties, since been transferred to Madras.

It was proposed to amalgamate in a similar manner the services of the North-Western Provinces and Oudh, Bengal and Assam, but the Local Governments opposed this at the time, and equality of promotion on these small lists can only be maintained by occasional inter-provincial transfers.

The growth and gradual development of the present Provincial Service is somewhat as follows :—

In the beginning, before the advantage of special training was recognised and for some time after, when the number of professionally trained candidates were less than the demands of the service, young gentlemen were appointed as Sub-Assistant Conservators. They entered

the service with the expectation of being eventually transferred into the upper grades of the service. Many have succeeded, and some have reached the highest grades of the service and have done excellent service to the State. Some are Conservators now and at the head of important Native States, others trusted Deputies in the upper grades ; but there can be no question that the failures outnumbered the successes.

For many years past the Secretary of State has reserved to himself the right of recruiting the Imperial Service and of sanctioning any transfers to it from the lower grades. The last of such transfers were necessitated by the urgent requirements of Burma, owing to the annexation of Upper Burma. The reorganization of 1891 entirely shut the open door in this respect, but provided for better prospects in the Provincial Service itself.

Previous to this reorganization we had only 47 Sub-Assistant Conservatorships on salaries ranging from R175 to R250 per mensem, which continued to be available for the patronage of Local Governments, and which were, as a rule, given to young men of European extraction, though their education, technical and otherwise, was by no means superior to that of the Native Rangers who had passed alongside of them through the Dohra Forest School. It was evident that under these circumstances it was hardly pos-

sible to build up a thoroughly strong Executive Service, and it was recognized that in order to effect this and to attract the best men in sufficient numbers, the whole of the appointments of the Provincial Service must become prizes of the Executive or Rangers Service, and be obtainable only after service in the lower branches. This was the principle on which the Provincial Service was reorganized.

In the place of 47 appointments of R175 to R250, 86 were sanctioned on R250 to R350, to which six have since been added, making a total of 92. In addition to this, it was decided to gradually increase the Provincial Service by the transfer to it in the course of 20 years of 20 per cent. of the appointments held by the Imperial Service. The salaries of these appointments have been fixed at R350 to R600. During the last seven years 19 appointments have thus been transferred, leaving 24 to be similarly dealt with during the next 13 years. By this time the first appointments will have risen into the higher grades.

When the reorganization was first promulgated, sufficiently qualified men were not available, and young men of European extraction grasped the situation more rapidly, and came into the service in considerable numbers. The first who came had naturally fairly rapid advancement, but as matters settle themselves down the fact must not be lost sight of that, though there will be prizes in the course of

the next 13 years up to R600 per mensem, the average pay of the combined Executive and Provincial Services will amount only to R134.

The slowest to develop, and even at present the most backward, was the Executive Service. At the outset all work had to be done by the few officers of the Controlling Staff, or it was not done at all. We had to find our *garde general* in our *oberförster*, the officer in charge of the administrative unit. It was naturally a question of the greatest difficulty in almost every province to obtain men fit for the work, and their engagement rested entirely in the hands of Divisional officers and Conservators. Some good men were doubtless obtained, but also many a useless Baboo, with no idea of, nor interest in, forest work. Gradually an improvement took place, and the establishment of the Forest School at Dehra Dun exercised from the very outset a decidedly beneficial influence. The officers in the Executive Staff had, however, even then no regular organization, they were appointed as they were wanted and had frequently nothing to look forward to. It was, in consequence, difficult to obtain suitable candidates.

Both Madras and Bombay took the lead of the provinces in the reorganization of their Subordinate Services, but that of the former province was entirely inadequate. A general scheme for the reorganization of the Executive and Subordinate staffs was framed in 1887, but

temporarily dropped, pending the reorganization of the Controlling Staff. When this had been finally sanctioned by the Secretary of State in 1891, the scheme, brought up to date, was resubmitted, but was finally sanctioned only in 1896.

The cost of the Executive and Protective Forest Services in the Bengal and Madras Presidencies was raised from R8,77,422 to R11,98,068, and now stands, including Bombay, as follows :—

EXECUTIVE SERVICE.

Rangers, from R2,49,210 to R3,96,204 per annum.

PROTECTIVE SERVICE.

Deputy Rangers and Foresters, from R3,06,060 to R3,67,224 per annum.

Guards from R7,25,928 to R8,40,696 per annum.

In many parts of India the provision is already found insufficient, and in some cases it has had to be augmented, though but a few years have lapsed since the sanction was obtained. The time cannot be far distant when a general strengthening of the Rangers class will be found both advisable and profitable; and, as the Department advances in revenue and utility, which it is sure to do, the number of Rangers may probably with advantage be doubled. The pay in the Rangers Service has been improved under the last reorganization, the highest grade now being R150 instead of R125 per mensem, and a matter of even greater importance is that the various grades have been

so arranged that the officers may count on a steady promotion. The greatest boon of the reorganization, however, is that members of this service are now, from the time they enter it, candidates for the Provincial Service, and eligible to rise to Extra-Deputy Conservators of the 1st grade on ₹600 per mensem, whereas in former times this service was practically cut short at ₹125.

In the same way Deputy Rangers, who have obtained the necessary certificate in the Lower or Vernacular Class of the Forest School, can now by good service obtain entry into the Rangers class; deserving Foresters may rise into the Deputy Rangers' class; and Guards, with sufficient education and of special merit, may become Foresters. The whole service, especially the Rangers and Provincial Services, have been designed with a view of attracting the most suitable classes of natives of the country.

The Inspector-General of Forests is the professional adviser of the Government of India and Local Governments, controls the Forest School at Dehra Dun, Forest Surveys and Working-Plans, and in regard to these, exercises the function of Local Government on all matters connected with these subjects and forest administration generally. He may write officially to the Government of India and Local Governments, and on matters which involve no administrative or general policy to Conservators in the various provinces; however, to

those in Madras and Bombay he may correspond only through the local Secretariat in charge of forest matters. The Inspector-General of Forests also assists the Government of India in dealing with the forest business which comes before them, and submits cases direct to the Secretary.

Conservators of Forests, whether in charge of the forest business of a whole Province, or a Circle forming part of a Province, are regarded as the head of the Department, and are directly subordinate to the Local Government, with the exception of Madras, where the Board of Revenue intervenes; and of Berar, Coorg and Ajmer, where the business is carried on through the Commissioners. Conservators hold the most responsible position in the control of the forest administration in India, and can exercise a greater direct influence as regards the application of correct conservative principles and on the prosperity of departmental administration, financial and otherwise, than any other officer in the Department. These appointments are therefore made by selection, and seniority alone on the Provincial lists of Deputy Conservators gives no claim to such posts. In the provinces forming the Bengal Presidency, the Government of India have reserved to themselves the right to make these appointments from all the Provincial lists, without reference to the place in which a vacancy may occur. For this purpose all Local

Governments submit annually their recommendations as regards all officers falling within the circle of pending selection. Conservators in the Bengal Presidency are kept on a special Government of India list, and are liable to transfer to any province. High qualifications are consequently required, and the fact that an officer is suitable for a small charge or special province is not admitted as a reason for selection. In Madras and Bombay, Conservators are appointed by the Governments of those Presidencies, but the principle of selection is the same.

One of the most important appointments amongst Conservators is that of Director of the Forest School, who is also Conservator of the School Circle.

A Conservatorship (whether of a Province or of a Circle) is divided into a number of Divisions. Each of these is in charge of a member of the Controlling Staff. As a rule, the more important Divisions are in charge of officers of the Imperial Service and the minor ones of officers of the Provincial Service. These officers, though in many provinces placed in subordination to the Chief Civil officers of the district in which their charges are situated, have practically a free hand to carry out their professional work under the control of the Conservator. The Divisions are again divided into Ranges held by either junior officers of the Provincial Service or by Rangers, and Deputy Rangers, and

in some cases, owing to an insufficiency of the Rangers staff, still by Foresters. The Range officer is our standby. He is the executive officer in the tract of forest in his charge, and is directly responsible to the Divisional officer for the protection and working of the forest in each detail, and it is and becomes more and more essential every day that he should possess a high technical education.

In special works he is assisted by Foresters. For protective purposes his Range is divided into a number of beats in charge of Forest Guards.

The entire organization now stands as follows :—

Imperial Service—

Inspector-General of Forests	1
Conservators	19
Deputy Conservators	117
Assistant Conservators	63

Provincial Service—

Extra-Deputy Conservators	5
Extra-Assistant Conservators	107

Executive Service—

Rangers	437
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Protective Service—

Deputy Rangers and Foresters	1,226
Guards	8,533

TOTAL . . 10,508

When the Forest Department was first started, the officers were generally placed under the direct orders of the Conservator of Forests, who in his turn was responsible to the Local Government. Soon, however, it was felt that the officers were in a somewhat isolated position, and that often friction took place between them and the ordinary Civil and Revenue authorities of the country. Hence the desire sprang up to connect the two Services more closely, and systematic proposals for giving effect to this were put forward by Mr. Brandis, late Inspector-General of Forests to the Government of India, when submitting a scheme for a reorganization of the Bombay Forest Staff in 1870. The plan then adopted consists of the appointment of a "District Forest Officer" to each district or collectorate, who is in charge of all forest matters in the district, and entirely subordinate to the Collector, through whom he corresponds with the Conservator. The next step in this direction was taken by the Chief Commissioner of the Central Provinces, who introduced in 1877 a modified system, according to which the Conservator and his Assistants remain in independent charge of all Reserved Forests, while the District Forest Officers are subordinate to the Deputy Commissioners regarding all Unreserved Forests. A further modification was introduced by the Government of the North-Western Provinces and Oudh in 1880, by which the District Forest

Officer is made subordinate to the Collector, his correspondence being arranged in two classes; that referring to accounts, establishments and a few other subjects is sent direct to the Conservator of Forests, while that on all other subjects is submitted by the District Forest Officer to the Collector, who forwards it to the Conservator. The same system was introduced into Assam on the 1st January 1882, and a similar arrangement has been in force in Burma since 1880. In Bengal the subject was under consideration for a number of years, and arrangements were finally made to establish the connection between the Civil and Forest administration in most districts. The system has, however, been modified in some parts of the country, by placing a senior Deputy Conservator of Forests under the orders of the Commissioner of the Division, instead of under those of the District Officer. In the Hazara and Rawalpindi Districts of the Punjab, the Forest Officers have for many years past been nominally subordinate to the Deputy Commissioners. In 1881 proposals were submitted to make the system general in the Province, and this has since been done. In Madras a system similar to that adopted in Bombay has been in force for some time, but the arrangements were somewhat modified, and the Conservator is only an inspecting officer with powers of finance and establishments. The advantages of this system have, I think, never been proved.

At the suggestion of Dr. Schlich, Inspector-General of Forests, a similar system was introduced into Berar. These measures are calculated to be of considerable importance for the purposes of forest conservancy in India. The Forest Department has become an integral part of the general administration, and jealousy and friction about lands and revenue, which existed, have largely disappeared, the Collector or Deputy Commissioner having become directly interested in the administration of the forest lands, and a sufficient safeguard has now been established that the forest law is applied in a judicious manner, and that the requirements of the people of the district are duly considered. On the other hand, the just demands and requirements of forest conservancy are better attended to under the full authority of the head of the district, while full control over the departmental finance, the organization and the technical part of the work has been reserved to the Conservator of Forests—an arrangement which alone will ensure a proper continuity of the work of the Department.

*Proprietary status
of forests in India.*

When the organization of a special department for the administration of the State forest property had been decided upon, the primary question naturally arose—What is State property?

The proprietorship of the forest land at the time of the British occupation varied in accordance with the historical and political

development of each province. Where the population had settled in joint village communities, any forest or waste land that fell within their boundaries was, as a rule, considered as common property—a fact that has been recognized in all settlements made after the British occupation of the country. In the case of ununited villages, no right to the waste was ever recognized. The old Rajas claimed all areas which were not actually brought under cultivation; but any person who required uncultivated land for the purposes of cultivation could obtain whatever he wanted without much difficulty. The rest was always and by every one recognized as the property of the rulers, and from them inherited by the British Government by right of conquest. The cultivators living in ununited villages never had any proprietary rights except in the areas actually under cultivation, though they had, in some instances, doubtless acquired prescriptive rights of user.

The consequence of this was that where united villages were numerous and close together, as in the plains of the North-Western Provinces, the whole of the forest land was claimed, and justly so. The boundaries of the villages march together, and no waste, with the exception of some unculturable stretches of country, remained the property of the State. Thus here and in Oudh, below the Terai, but little forest was left in the hands of

Government. The unoccupied areas in these provinces are barren, resting on kunkar beds, and impregnated by such large quantities of salt as to make them unproductive. They are called *reh* or *usar* lands. Along the foot of the Himalayas lie the Terai and the Dûns. At the time of occupation by the British this part of the country was not so densely populated as the plains. It was unsafe and unsettled, swarming with tigers and other wild animals dangerous to man and beast, or destructive to crops, and was moreover considered uninhabitable by the peasants of the richer plains on account of the prevalence of malaria. The consequence was that large stretches of country remained unoccupied and unclaimed, and eventually fell to Government. Considerable areas of this country have since been granted away, but much remains still under forest, partly the property of the State, partly that of private parties. In the hills of British Kumaun, Jaunsar and Garhwal, the villagers only possessed their cultivated lands. The forest belonged to the State, though the cultivators had certain rights of user. The area of forests in the possession of private parties is estimated at 4,715 square miles of hill forest, 1,118 square miles in the Terai and Dûns, and 867 square miles in the plains. The forests and waste lands in the independent Hill States, the more valuable of which have been leased by the British Government, belong to the rulers.

It was different in the Punjab and the Central Provinces. Here we also find joint villages; but owing to the character of the country, which in either case contains much land either entirely unfit for permanent cultivation or culturable only at the expense of costly irrigation works, large unclaimed areas of waste lands intervened and these, though the actual village boundaries were often uncertain, were secured by settlement, as the unqualified property of the State. In the plains of the Punjab large areas of waste varying from a more or less compact forest to desert land, were found unoccupied at the time of the conquest of this province, though they even then doubtless formed the pasture ground of nomadic tribes and were still the home of cattle-thieves and robbers. These waste lands were, after a liberal provision had been made for the settled villages, declared the property of the State; but as cattle-thieves and robbers disappeared under a strong and just Government, the herds increased rapidly, and the greater portion of the forests in the plains can only be regarded as pasture grounds. Large areas have moreover been brought under cultivation by colossal irrigation works, and rich wheat-fields grow where a few years ago scattered herds of half-starved cattle roamed in search of sparse tufts of grass. The area still waste in the *bar*, the larger portion of which must, unless artificially irrigated, remain waste for ever, is the property

of Government. Thanks to the activity displayed in extending canal irrigation, these barren areas are rapidly contracting. Of the forest areas in the hills which once belonged to Government, large areas had and have since been abandoned during the earlier settlements.

The forest area still at the disposal of the State, and in which the State has proprietary rights, amounts to 7,433 square miles. The area of private forests is estimated at 3,000 square miles, but in some instances, the common grazing lands of village communities in the plains are included in this estimate; and such lands often produce no forest growth. The waste lands in Chamba and Bashahr belong to the rulers, but the more valuable portions have since been leased to the British Government. The areas leased amount in Chamba to 158 square miles of reserves and in Bashahr to 184 square miles of reserves and 210 square miles of unreserved forests. The waste lands and forest in the other Feudatory States of the Punjab, including Kashmir, are owned by their respective rulers. These areas, especially in Kashmir, are very extensive and include many valuable forests.

The Central Provinces contain large areas of forest lands of extremely varying value. At the time of the occupation of the country great portions of the province were but very sparsely populated; and though at the time of the first settlement the village communities were

treated with great liberality, enormous areas remained at the disposal of Government. The property of the State in forest areas amounts at present to 19,498 square miles, consisting for the most part of hills or lands which, if once denuded of forests, would become unprofitable. Enquiries which have been made in late years tend to show that the State forests in the Central Provinces contain some 3,000 square miles of land fit for permanent cultivation; and with regard to the large forest areas at the disposal of the State and the limited demand on them, the present policy is to alienate these areas in favour of agriculture. Owing to the fact that as yet we have failed to enforce any real forest protection over forests owned by private parties, it is hardly necessary to lay any particular stress on the extent thereof. It would, moreover, be very difficult to ascertain this with any amount of accuracy—35,000 square miles are probably below the mark.

The waste lands in Merwara were originally a crown domain belonging to the Raja, and were, as such, inherited by the British Government as absolute State property. They were, however, granted away conditionally at the time of settlement; but as the conditions of the grant were never fulfilled, Government has re-acquired some 114 square miles. In Ajmer, and in the independent States under the Rajputana Agency, a certain area of forest land belongs to the sovereign as a Crown estate,

whereas the rest is more or less the independent private property of Thakurs and other Chiefs and noblemen, over whose forest lands the Government has no control.

In Berar the villages are ununited, and the cultivators had therefore no original claim to the waste. The present total area of forest land is estimated at 4,175 square miles ; all of these, it is stated, belong to Government, and they have been placed under the direct management of the Forest Department.

In Coorg, Government inherited the rights of the Raja in the waste land at the time of annexation in 1834. The land was divided into *vargas* (farms), a collection of which made a *jama*, or estate. The farms include, as a rule, a portion of forests for the supply of firewood, bamboos, and *rab*, and some grazing ground. The amount of forest property remaining at the disposal of the State aggregates 887 square miles.

The forest area in Lower Burma is very extensive, and was practically the undisputed property of Government, though Karens and some other tribes were in the habit of clearing certain forest areas for cultivation, which were abandoned after one or two crops had been gathered. This method of cultivation, though it gives no proprietary right to the cultivators, has been practised so long and to such an extent that it has been found impossible to ignore the practice. The utilization of the

State property is thereby largely curtailed, and in some districts, where the population which subsists on *taungya* cultivation is specially dense, is entirely absorbed. By a Notification dated the 26th September 1853—that is, immediately after the conquest of Pegu—the forests in that province were declared to be the property of Government. The forest property at the disposal of the State, in both Upper and Lower Burma, is estimated at 14,706 square miles, which leaves a considerable margin for a final settlement with the *taungya*-cutting tribes.

The province of Upper Burma was annexed in 1887. It contains vast forest areas which had been the undisputed property of the late King and were, as such, inherited by conquest. A considerable portion of this extensive inheritance, however, comprising some of the most valuable parts thereof, was for some time in danger of being alienated. It was at first intended to leave the local Shan Sabwas in full possession of their States; and the sanads, which had already been approved of and sent to Burma for distribution, conferred the proprietary rights in the forests on the local chiefs within their respective territories, and did not sufficiently safeguard the interests of the British Government therein. Being acquainted with the previous conditions, I was able luckily before the sanads had been distributed to point out that the late Kings of Burma claimed *de jure*, and whenever strong

enough *de facto*, the sole proprietary rights in all forest lands in the Shan States ; and that in fact they had granted leases over considerable portions thereof ; and I was, after consultation with the Advocate General, the Local Government and some of the ex-ministers of the late King, fortunate enough to get the sanads altered. The forests in all the Shan States are now declared to be the property of the British Government as in the rest of Upper Burma.

The forests in Assam, which province was but sparsely populated at the time of occupation, still covered a considerable proportion of the total area. They belonged to the State ; and though large areas have, since British occupation, been abandoned, mostly with a view to encourage tea cultivation, the area still owned by Government amounts to 19,273 square miles, and it is estimated that 1,070 square miles, covered with some sort of forest, belong to private parties. Besides this there are parts of Assam—such as the Garo, Khasi, Jaintia, and Naga Hills—the whole of which remain more or less forest or waste, with next to no permanent cultivation, but where a sparse and scattered population lives almost entirely by *Jhumming*. In the Garo Hills, a very large tract of valuable Sâl forest was lost to Government when the district was annexed in 1874, as a former Deputy Commissioner of the permanently-settled district of Goalpara had drawn a line across the Garo Hills to the south of his

district, including these forests in some of the Goalpara zamindaries, though the latter had never held any owner's rights in the tract up to the annexation of the hills by Government.

Large waste lands exist in the newly acquired territories belonging to the Baluchistan Agency ; and though the greater part of the country is stony waste, juniper forests exist of a considerable extent and of large value. Government has doubtless an unassailable claim to these, but has not asserted it as yet.

In the Madras Presidency, the land which was at the time of the British occupation neither cultivated under the *raiyatwari* tenure nor held as a zamindari, was at the disposal of Government. The total area of forests and waste lands in the Madras Presidency amounts to some 94,000 square miles ; but of these, nearly one-third are culturable and assessed and only awaiting occupants.

The Bombay Presidency is geographically divided into Sindh and Bombay proper. The settlement has been conducted on the *raiyatwari* system, under which the actually occupied area only belongs to the cultivators. The area of forest lands, the property of the State, amounts in Sindh to 1,060 square miles and in Bombay proper to 13,852 square miles. The area of private forests in Sindh cannot be ascertained at present. In Bombay proper it is estimated to aggregate nearly 413 square miles.

Forest Laws.

Though it was thus known that the State had inherited extensive proprietary rights in the forests of India from the rulers by whom the territories were ceded, the actual status of the property and its extent were uncertain. This condition of things was probably quite in accordance with the state of society previous to British occupation, when every one was accustomed, without let or hindrance, to get what he wanted from the forest, and when consequently no demand existed for forest produce for sale, and when the ruler recognised no obligation to maintain the stability of the resources to meet such demands for sale or even local requirements.

It soon became evident that if this system were allowed to continue and grow unchecked, in the same proportion as cultivation increased and forest was cleared, the Government forest property would not only become valueless, but must soon be diminished to such a degree as to be incapable of supplying the just demands of the country, which it is the duty of a civilised Government to secure. The practical impossibility was also recognized for a Government to undertake the systematic management of a vast State property from which every individual can supply his wants free of charge, and which consequently yields no income from local sales.

It became evident that in order to effect the changes required, it was necessary to legislate in order to legalise the settlement and reserv-

ation of forest areas, as well as the assumption of the complete control of their management. The despot preceding the British Government allowed every one to take what he required, but reserved to himself full power to do, at any moment, with his property whatever he liked without let or hindrance. Nobody thought of opposing him in this respect. But though the Oriental Governments, from which the British Government inherited its forest property, never recognized a prescriptive right, it had to be admitted that, under the system originally in vogue, and which had remained entirely unchecked for some time after the British occupation, rights of user had in some instances been acquired by the legal process of prescription, in consequence of the substitution, or at least intermixture, of Western laws and ideas, in cases where it had been exercised neither by force nor secretly, but fully, openly, and unchecked, for 62 years. In some cases rights of user had been acquired by grant and sanad, and in others the officers in charge of the more early settlements gave up the right of the soil to the villagers, and reserved to the State only the trees growing on the land.

It was consequently necessary to discern, in the first instance, between forests in which the right of the State was still absolute; forests which were the property of the State, but which were burdened with legal rights, prescriptive or granted; and forests which were the property of

individuals or communities, but in which the State had rights over all or certain kinds of growing trees, and then to provide for a legal settlement on these points.

The first forest laws are of interest only in so far as they prove the difficulties that had to be overcome before a comprehensive and practical measure was devised for a legal separation of rights in forest property. The growth of forest legislation was somewhat as follows :—

When forest administration was first started in India, some local rules were promulgated in several provinces, of which the only one still unrepealed is the Hazara Rules, which were originally issued in 1875, recast in 1878 and finally amended in 1893. They provide for the creation of State forests under the Land Revenue Settlement and are therefore unobjectionable.

In 1865 the first Indian Forest Act was passed, under which a large number of local rules was promulgated—*viz.*, the British Burma Rules of 1865, the Central Provinces Rules of 1865, the Rawalpindi Rules of 1865, the North-Western Provinces Rules of 1866, the Oudh Rules of the same year, the Berar Rules of 1871, and the Coorg and Bengal Rules of the same year. In 1869 it was considered necessary to pass Act VII, to give validity to certain rules relating to forests in British Burma not falling within the scope of Act VII of 1865. This Act was repealed by Act XIII of 1873, “the Burma Timber Act.”

Act VII of 1865 was very defective, and a revised Bill and a Memorandum, explaining very clearly the necessity for new legislation, were submitted to the Government of India by Mr. Brandis in 1868. This Bill was fully discussed by Local Governments and was re-drafted, and came again under the consideration of the Government of India in 1871. Again, at a Forest Conference held in Allahabad in 1873-74, the defects of Act VII of 1865 were brought prominently to notice. The main deficiencies were those noticed by the Hon'ble Mr. Hope in the Viceregal Council which met on the 6th March 1878:—

“It drew no distinction between the forests which required to be closely reserved, even at the cost of more or less interference with private rights, and those which merely needed general control to prevent improvident working. It also provided no procedure for enquiring into and settling the rights which it so vaguely saved, and gave no powers for regulating the exercise of such rights without appropriating them. It obliged you, in short, either to take entirely, or to let alone entirely. On control over private forests, in the general interests of the community, it was absolutely silent. For duties on timber, even those actually levied, it gave no authority. Protection for Government forests, so interlaced with private ones as to be in chronic danger of plunder, there was none. In various minor points also it was deficient.”

In the year 1878 the Indian Forest Act VII was passed, extending to all Provinces of British India, except Madras, Burma, the Hazara District in the Punjab, Ajmer, Coorg, Berar, and Baluchistan.

The Forest Act provides for the constitution of Reserved forests and Protected forests. When the Indian Forest Act was first drafted, it was intended to create only one class of demarcated State forests, but to provide for a limited protection of all other Government forest lands generally, until it could be decided what areas should be maintained permanently as forests by constituting them demarcated or reserved forests. The same position has actually been maintained in the Forest Act as passed into law, which in nowise imposes a demarcation of a forest area before it can be declared a protected forest. The only material difference is that the Act requires that the nature and extent of the rights of Government and private persons should be enquired into and recorded previous to such declaration, or imposes upon the Government the duty of instituting such enquiries in case it was found advisable to issue the declaration without delay. Existing rights are protected by the Act pending such enquiries. The constitution of reserved forests is surrounded by every safeguard against any possible infringement of private rights and secures a permanent settlement, whereas the second class of *demarcated* State forests, known as "Protected forests," offer but an insufficient guarantee for their stability and protection. Existing rights are recorded in such forests, but not settled. They may increase and new rights may spring up without limit, even to the absorption of the property. The

correctness of this has been acknowledged in practice by the various Local Governments, and we have now some 81,400 square miles of Reserves and only 8,800 square miles of Protected forests, large areas of which have since been converted or are in the course of conversion into Reserves. In 1889-90 there were 56,000 square miles of Reserves and nearly 30,000 square miles of Protected forests.

The Act provides in Chapter III for the constitution of Village forests in a somewhat roundabout way. Village communities and private persons have a right to expect from the Government that their property in forest land should be protected, not only against trespass, but also against the accrual of new rights ; however, the procedure demanding that the area should first be created a Government Reserved Forest, which unnecessarily arouses the suspicion of the owners we intend to benefit, was faulty and the Chapter has remained a dead letter.

A separate Act was passed for Burma in 1881, as the Chief Commissioner declined to extend the Indian Act to his Province, owing to certain defects, but mainly with regard to the misunderstanding to which Chapter IV and its objectionable title were likely to lead. In this Act XIX of 1881 a Chapter, practically on all fours with Chapter IV of the Indian Act, but not providing for any record of rights, carries some protection to all waste and forest lands the property of Government, until such

time as the selection and demarcation of State forests (Reserves) shall have been completed. Worthless lands, or such as are required for other purposes, can then be abandoned, and the Chapter will no longer be required, unless it be for the purpose of maintaining the Government right in the royal tree, Teak, when standing on lands not the property of Government. The Chapter relating to village forests purports to be an improvement on the Indian Act, but so far it has not proved workable, for the reason that a clause (34) has been inserted to the effect that any existing rights of any person in or over any village forest shall not be affected. Without the curtailment of certain rights of user, or at any rate the regulation of the enjoyment of such rights, nothing would be gained by constituting the forest a village forest, beyond a guarantee against new rights. As, however, such forests as it is most necessary to bring under this Chapter have been and are being indented upon to such an extent as to endanger their existence, their permanent maintenance can only be assured by bringing the concessions to villagers within the possible yield of the forests.

When the Indian Forest Act was under consideration, the Madras Government declared that it could not be extended to Madras, as the formation of Reserves, as contemplated by that Act, could not be accomplished. The rights of the villagers over the waste lands and jungles were considered to be of such a nature as to

prevent Government from forming independent State property. Madras, therefore, preferred to legislate locally. Two separate drafts were consequently submitted from Madras, and a new Act was finally submitted for the concurrence of His Excellency the Governor General in Council. This Act was found unsuitable from an administrative as well as a legal point of view, and was vetoed in Council. Mr. Brandis was then deputed to Madras in October 1881; and one of the most important of the many valuable results of this deputation was the passing of the Madras Forest Act, No. V. of 1882, with effect from the 1st January 1883.

The Madras Act is framed on the same general lines as the Indian and Burma Acts, but is improved in several points. The Chapter on the constitution of Reserves is more logically arranged, and the procedure is somewhat simplified. The Chapter on the protection of land at the disposal of Government not included in reserved forests, which again has the same object in view as the Chapter on Protected forests in the Indian Act, shows a great improvement, even on the provisions of the Burma Act. There is no reason why with certain alterations, the Madras Act should not be made applicable to the whole of India. But the Madras Act has one great defect, in as far as it admits of an appeal or suit beyond the District Forest Court.

A large extent of country had in several

provinces already been placed under some sort of reservation under the provisions of Act VII of 1865; and in order not entirely to lose the results of previous work, a provision was entered in the modern enactments by which Government was empowered to declare any such areas Reserved and Protected forests, under the proviso that any rights of Government or private persons over any land and forest produce in any such forest had been enquired into, settled, or recorded in a manner which the Local Government thought sufficient, or would be thus enquired into, settled, and recorded after the declaration if the former enquiries and settlement were considered insufficient.

All three Acts provide for the control over forests and lands not belonging to the State, if such control appears necessary for the public weal, or if the treatment such forests have received from their owners injuriously affects the public welfare or safety; but the provision that the owner of the land can require the Government to acquire the land in question under the Land Acquisition Act has rendered special legislation necessary when such interference was deemed necessary as for instance in the Hoshiarpur *choks* in the Punjab.

The Indian, Burma, and Madras Acts provide for the promulgation of rules by Local Governments under several sections of the Acts. Numerous sets of local rules have been drawn up and passed since the Acts came into force;

those promulgated under Chapter IV of the Indian Forest Act differ often district by district and occasionally in the same district and thereby place not only the Forest Administration, but the surrounding population, in a maze of bewilderment.

In 1886 the Berar Forest Law was sanctioned. All waste in Berar which had not been alienated under settlement was the indisputable and entire property of the State. Hence the creation of State forests became purely a selection, and the sections treating of this creation are very simple. The same holds good as regards Baluchistan, for which Province a Forest Regulation was passed in the same year, which has since been amended in 1890. A more important measure was the Upper Burma Forest Regulation, No. VI of 1887. It moves generally on the lines of the Burma Forest Act, entirely so with regard to the creation of Reserves and settlement of rights. It was amended in some details in 1898. As regards property-rights and user, it was distinctly laid down that the practice of shifting cultivation conveyed no right and could be abolished at the pleasure of Government.

In 1890 the Upper Burma Forest Regulation was extended to the Shan States.

The Assam Forest Regulation, which was sanctioned in 1891, was entirely formulated on the Upper Burma Regulation.

This chapter cannot be closed without

mentioning the valuable assistance and influence of Mr. B. H. Baden-Powell, who was for some time Conservator of the Punjab and afterwards officiated as Inspector-General of Forests, in placing forest legislation in India on a sound basis.

*Constitution of
State forest
property.*

The legal constitution of State forest property followed the gradual development of the forest laws by means of which this became possible. Previous to 1865, there were practically no defined State forests; though the necessity of a separation of proprietary rights had been felt from the very outset, as is evidenced by some of the earliest despatches, resolutions and reports mentioned in the introduction.

The Forest Act, VII of 1865, for reasons already mentioned, lent itself but badly to the constitution of forest reserves, and as a matter of fact the Indian Forest Act of 1878 did not *per se* accept the forest settlement work done under the earlier enactment. However, considerable activity had been displayed and the work done could not be entirely ignored, and therefore Act VII of 1878, and subsequent Acts drawn on the model thereof, permit, in section 34 and corresponding sections, the Local Government, after consideration of the rights of the Government and private persons in all forest lands or waste lands then under its executive control for purposes of forest conservancy, to determine which of such lands (if any) can, according to justice, equity and good conscience, be classed as Reserved forests or

Protected forests under this Act, and to declare, by notification in the local official Gazette, any lands so classed to be Reserved or Protected forests, as the case may be. Provided that such declaration shall not affect any rights of the Government or private persons to or over any land or forest produce in any such forest, which have, previous to the date of such declaration, been inquired into, settled and recorded in a manner which the Local Government thinks sufficient. Provided also that if any such rights have not on such date been so inquired into, settled and, recorded, the Local Government shall direct that the same shall be inquired into, settled and recorded in the manner provided by this Act for Reserved or Protected forests, as the case may be; and until such inquiry, settlement and record have been completed, no such declaration shall abridge or affect such rights.

The following table shows to what extent the powers conferred under section 34 and corresponding section in other forest laws were made use of:—

Province.	Reserved Forests.	Protected Forests.
	Sq. ms.	Sq. ms.
Bengal	2,967	1,925
North-Western Provinces and Oudh.	8,260	100
Punjab	298	...
Central Provinces	19,383	...
Burma	2,440	...
Assam	1,983	689
Coorg	241	309
Bombay	8,120	5,497

In Bengal great care had been taken in the earlier settlements, and it was decided that the separation of State and Private rights had been sufficiently attended to. The same declaration was made as regards the Reserved forests in the Central Provinces, where this waste forest area had been, in spite of the greatest liberality to the people of the country, excised as undisputable and unburdened Government property in the course of land settlements.

In Assam and Coorg also, no further inquiries and settlements regarding the forest areas declared to be Reserved forest were required. In the North-Western Provinces and Oudh, however, and in the Punjab it was doubtful whether the legal status of the forests gazetted under section 34 had been sufficiently enquired into, settled and recorded and subsequent settlements became necessary. In Bombay the declaration under section 34 was made with the full knowledge that the rights of the people in the forests in question would be subject to further enquiries and settlement. These operations were commenced at once, and have ever since been carried out with great vigour. As many as six Civil Officers have been employed as special Forest Settlement Officers at one and the same time—whilst others were engaged on this work in addition to their ordinary duties.

Reservation in Burma in the early days was carried out in a somewhat haphazard way. At

the end of 1874-75 there were some 563 square miles of reserves; but in nearly all of them, excepting the fuel reserves in the plains, shifting cultivation was practised and no attempts had been made to come to a legal settlement with the people engaged in *taungya* cultivation. In 1876-77, the writer, who was at that time Conservator of Forests in charge of the Pegu Circle, directed the forest settlement of the Thonzé reserve, and in conjunction with the late Mr. A. O. Brown of the Burma Civil Service and Mr. Popert, late senior Conservator of Forests in Madras, we succeeded in making a satisfactory settlement with the Karens.

The areas set apart for the Karens, who were found domiciled within the limits of the forest area, were demarcated, but, nevertheless, included in the State reserves. Within these areas the following rights were conceded:—

- (a) to cut *taungyas* under the sole restriction of not destroying Teak trees above one cubit (18 inches) in circumference.
- (b) to fire-trace and to burn such *yahs*, provided they take the necessary precautions against the fire spreading into the forests;
- (c) to the free supply, for their domestic use, of any forest produce except Teak.

The inclusion of the Karen areas within the reserved areas—

- (a) protects the original inhabitants and

- their descendants against the encroachment of new settlers ;
- (b) prohibits the destruction of *taungya* grounds by traders in unreserved forest produce.
- (c) enables the Forest Department to cancel, within the areas, the rules with regard to reserved kinds of timber altogether and to relax those concerning Teak to a great extent ;
- (d) facilitates the supervision of export from reserves and the control of forest fires.

This procedure has been proved by time and practice ; for though originally carried out under an incomplete law, it has never been changed under improved legislation.

As regards the villages, the usual procedure was adhered to.

When the Burma Forest Act was passed in 1881, the area of fully settled reserved forest had increased to 2,440 square miles, which were declared such under section 30 of the new Act.

When the Madras Act of 1882 was passed, 130 square miles in the Southern Circle were constituted reserve under Section 25 of this Act.

Further progress of constitution of Reserved forests under modern legislation.

Under the improved forest laws now in force, forest settlement has proceeded with more or less vigour in the several provinces of the Empire.

By the end of 1881-82 there were 46,213 square miles of Reserved and 8,612 square miles of Protected forests; with the close of 1884-85 there were 49,214 square miles of the former and 13,103 square miles of the latter class. At the end of 1897-98 the area had increased to 51,414 square miles of Reserves and had decreased to 8,845 square miles of Protected forests.

The area of Protected forests is constantly varying, for though new areas may be taken up, others are, after final settlement, absorbed in the class of reserves.

The comparative results of all forest settlement may be gathered from the following table, which has been compiled from such information as is available in the office of the Inspector-General of Forests and can lay claim to accuracy only as regards the entries under "Reserved" and "Protected" forests:—

PROVINCE.	Total area of Province according to Survey of India.	Deduct Feudatory and Tributary States.	Balance under the Government of India.	Area cultivated.	FORESTS UNDER CONTROL OF THE FOREST DEPARTMENT.				Balance including private and other forests, waste lands and areas for which no returns are available.	Proportion of Reserves to area under the Government of India.
					Reserved.	Protected.	Unclassed.	Total.		
	Sq. Mls.	Sq. Mls.	Sq. Mls.	Sq. Mls.	Sq. Mls.	Sq. Mls.	Sq. Mls.	Sq. Mls.	Sq. Mls.	Per Cent.
Bengal	191,800	38,652	153,148	80,973	5,880	3,160	4,034	13,374	58,801	3.83
North-Western Provinces and Oudh.	113,057	6,908	106,149	57,580	3,851	94	43	3,988	44,581	3.62
Punjab	149,110	33,324	110,786	41,909	2,283	3,011	2,139	7,433	61,444	2.06
Burma (Lower)	83,557	...	83,557	10,358	7,373	...	...	7,373	65,826	8.82
Burma (Upper)	85,411	8,201	77,210	6,447	7,333	...	...	7,333	63,430	9.49
Central Provinces	115,886	29,435	86,451	30,272	19,206	...	292	19,498	36,681	22.10
Assam	45,377	3,997	41,380	5,284	3,590	...	15,633	19,273	16,823	8.67
Coorg	1,582	...	1,582	378	238	649	...	887	317	15.0
Ajmer	2,646	...	2,646	766	139	...	10	149	1,731	5.25
Barar	17,757	...	17,757	11,490	4,175	...	...	4,175	2,033	23.57
Madras	150,868	9,609	141,259	46,819	13,775	...	5,478	19,253	75,187	9.75
Bombay	187,765	64,717	123,048	58,326	13,281	1,631	...	14,912	49,810	10.7
TOTAL	1,144,766	199,843	944,923	350,611	81,194	8,845	27,679	117,648	476,684	8.58

A map, showing the progress in the constitution of State forest property, is appended.

The various forest laws in India make it *Forest settlements.* quite clear that the object of a forest settlement is, in the first instance, to fix and define the legal status and extent of the proprietary rights of the State in any forest or waste land, constituted or declared to be forest within the meaning of the Forest laws, and, consequently, to enquire and record to what extent the proprietary rights of the State are limited by legally existing adverse rights of private persons or communities: secondly, to arrange for the exercise or commutation of adverse rights so recorded, in order to allow of the property being managed with the view of obtaining the best possible return, both for the present and in the future, for the general public.

The settlement of a forest, which has resulted in its constitution as a Reserve, merely determines the rights of the Government and private persons over the forest, and in no way aims at prescribing the agency by which, or the manner in which, the forest is to be administered. The way in which a forest may be managed, or the requirements which it is intended to meet, are, in every instance, dictated by local circumstances. Thus a Reserved forest has not, necessarily, the object, as is frequently believed, of producing large timber for export or public works, but, more often, that of supplying the

local demands in smaller timber, fuel, grass, or any other forest produce. A forest may be said to fulfil its highest function when it produces, in a permanent fashion, the greatest possible quantity of that material which is most useful to the general public, and at the same time yields the best possible return to the proprietor.

The settlement of forest lands under the forest laws is a step which fixes for ever the respective rights of the Government and private persons over the lands; while the management of the forest is a matter that can be regulated by executive orders at any time, and in deference to altered requirements and varying demands. However, the legal obligations imposed at the time of settlement are the first charge on the management.

The rights claimed and admitted during such settlement must be actually existing rights, vested in an individual or person, or in a definite body of persons, such as, for instance, a number of co-owners, or a village community. They may be rights in gross, unconnected with the ownership of immovable property (houses or land), or they may be rights attached to the ownership of such property. They may be rights enduring only for a certain period, or for the life of the person in whom they are vested, or they may be rights which will pass to the heirs of that person, or pass in perpetuity with the property to which they are attached. But

they must be existing and vested in some person, or body of persons, who can claim them at the time of settlement.

Under any circumstances, the burden which the forest property has to bear is, as the laws stand, clearly defined, the amount of timber or firewood which it annually owes to right-holders should be fixed in perpetuity, as well as the number of cattle which may graze in it and the seasons during which they are to be admitted, and finally the total extent of right should never exceed the productive power of each forest property.

The majority of forest settlements have been made on this strictly legal basis. They do not preclude Government from utilizing the areas settled in any way they may think fit, or to benefit the surrounding population by the free grants of forest produce contained in such reserves.

The title to the forest property having been *Demarcation*, secured, its permanent demarcation was the next step to be provided for. Progress was naturally slow at the outset, but as the Department grew in strength, the work was taken in hand in every province with great vigour, and at the close of 1897-98, 93,068 miles of boundaries, out of 141,204 miles requiring artificial demarcation, were complete and in good order; as a matter of fact it may be said that the work is up to date, for the boundary lines still to be provided with permanent pillars and posts

mainly represent the boundaries of lately sanctioned reserves.

Forest surveys.

Almost from the very outset it was found that the ordinary topographical maps were insufficient in accuracy and scale for the purposes of forest administration, and as the areas set apart as State forest property increased, and a more systematic and conservative treatment was gradually introduced, the demand for suitable maps grew more and more acute. For several years this want was supplied by provincial and local agency, but it soon became evident that these efforts were in most instances not sufficiently controlled. Here and there, no doubt, useful and reliable maps were produced, but generally speaking the administration obtained insufficient *data* in comparison with the amount of money which was spent on surveys throughout the country, and the maps varied far too much in character to make them generally intelligible and useful. There was a great variety in scales and in the signs and colours used to indicate topographical detail and the character of the forest, which varied in each province and frequently within one and the same province; and even those maps which sufficed for local requirements were generally useless for geographical purposes, as they were unconnected with each other or with the surveys executed by the Survey of India.

The annual accounts showed, moreover, a gradual but steady increase of expenditure

under the head of surveys, which amounted in—

R

1870-71 to 31,993 (Actuals)

1871-72 to 44,826 (Revised Estimate)

1872-73 to 48,400 (Budget Estimate)

exclusive of the pay and travelling allowance of officers and the feed and keep of elephants employed by them, which were charged to other budget headings.

It was consequently decided to constitute a separate agency for forest surveys, and thus the Forest Survey Branch was created by the Government of India's Resolution No. 19, dated the 17th October 1872, and placed under the immediate control of the Inspector-General of Forests. Captain F. Bailey, R.E., at the time a Deputy Conservator in the North-Western Provinces, was entrusted with the organization of the Forest Survey Branch, and was appointed Superintendent of Forest Surveys and Working-Plans. This officer displayed great energy, ability and tact in organizing this new branch of the service and in bringing it into complete harmony with the Survey of India, who have ever since fully accepted the Forest Survey Branch work for topographical purposes. He presided over the branch for ten years, but during the second quinquennium, when he was also entrusted with the organization of the Forest School—of which more hereafter—the actual working fell to a great extent on Mr. W. H. Reynolds, who had been connected, as Assistant

to Captain Bailey, with the new organization from the outset.

In 1883-84 Mr. Reynolds was placed in independent charge of the Forest Survey Branch, and has ever since conducted this important business with great credit to himself and profit to the State. Natives of the country were formerly not utilized in professional surveys in India, but in subordinate positions and on unimportant work. Mr. Reynolds has proved in practice, by employing a constantly increasing proportion of fairly educated and practically and carefully trained natives on work which was formerly only entrusted to Europeans, that the native agency is sufficiently trustworthy and able too for the more important branches of survey work. He has thereby materially reduced the cost-rates of the Forest Survey Branch without in the least impairing the accuracy and neatness of the maps turned out, which can stand comparison with those produced by any other agency. In doing this Mr. Reynolds has loyally and successfully carried out the principle of the Indian Forest Department to employ natives of the country as far as possible and to educate and train them for their work.

In addition to this we have constantly increased the outturn and have thereby lowered the proportion of the cost of control to that of execution, so that the present cost-rate probably represents the minimum for which a reliable survey can be turned out in India.

The following table shows the quinquennial outturn of the surveys completed and the total cost of the Forest Survey Branch for each period :—

PERIOD.	Square miles for period.	Total Expenditure for period.	Average number of square miles per year.	Average expenditure per year.	Average expenditure per square mile.
		R		R	R
1873-74 to 1877-78 .	1,284	3,13,069	260	62,614	241
1878-79 to 1882-83 .	1,599	2,20,605	820	44,121	138
1883-84 to 1887-88 .	2,973	3,27,694	594	65,539	110
1888-89 to 1892-93 .	6,454	5,25,661	1,291	1,05,132	81
1893-94 to 1897-98 .	10,380	8,01,241	2,076	1,60,248	77

The standard survey of the Forest Survey Branch is 4 inches to the mile, but during the later periods the following surveys were made on a larger or smaller scale :—

	10"	2"	1"
	Sq. miles.	Sq. miles.	Sq. miles.
1883-84 to 1887-88 .	...	1,896	...
1888-89 to 1892-93 .	439	10	1,750
1893-94 to 1897-98 .	816	...	2,192
TOTAL .	1,255	1,406	3,942

In 1873, when the Forest Survey Branch was constituted, the Survey of India was still expanding and had more work than it could accomplish, and it was at the time contemplated to expand the Forest Survey Branch so as to meet all demands for forest surveys in India. This programme was not, however, carried into effect. The requirements of the Department for reliable maps rose more rapidly than was anticipated, and though it might

have been possible to arrange for this by a corresponding increase of the Forest Survey Branch, it was decided, in view of the large survey establishments already in the service of the State, for whom employment would have to be found within a few years, not to expand the Forest Survey Branch, but to utilize the services of parties of the Surveyor-General's Department for forest surveys as their services became available from time to time.

The first forest surveys executed on the scale of 4" to a mile by the Survey of India were those of the Thana District in the Bombay Presidency, carried out in conjunction with the survey of that district. They were begun in 1881-82. In 1882-83 the survey of the Dangs in the same Presidency were added. During the next year a Survey of India party was also employed in Burma, and work was carried out in the Rawalpindi Division of the Punjab. Since then parties of the Survey of India have been constantly employed on forest surveys in Bombay and Burma. In 1887-88 the Survey of India Department extended its forest survey operations to Madras and the Central Provinces, where work has been carried on by them ever since.

The following table shows, in square miles, the extent of forest surveys carried out both by the Forest Survey Branch and the Survey of India Department in the various provinces till the end of 1897-98. A map showing the progress up to date is also appended:—

Survey Year.	BENGAL.		NORTH-WESTERN PROVINCES AND Oude.				PUNJAB.		CENTRAL PROVINCES.		BUTMA.		ASSAM.		DEHRA.		HADD- RAS.		BOMBAY.				By Forest Survey Branch.	By Sur- vey of India Depart- ment.	Total.
	Scale.		Scale.				Scale.		Scale.		Scale.		Scale.		Scale.		Scale.		Scale.						
	4"	2"	12"	8"	4"	2"	4"	1"	16"	4"	4"	2"	4"	2"	4"	16"	8"	4"							
1873-74*	145	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	145	...	145	
1874-75*	288	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	288	...	288	
1875-76*	313	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	313	...	313	
1876-77*	211	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	211	...	211	
1877-78*	327	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	327	...	327	
1878-79*	343	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	343	...	343	
1879-80*	318	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	318	...	318	
1880-81*	290	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	290	...	290	
1881-82*	179	27	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	265	...	265	
1882-83	300	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	361	...	361	
1883-84	53	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1884-85	36	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1885-86	
1886-87	
1887-88	
1888-89	
1889-90	
1890-91	
1891-92	
1892-93	
1893-94	
1894-95	
1895-96	
1896-97	
1897-98	
Carried over	151	...	3	149	2,831	205	456	...	230	1,065	319	...	...	931	1,215	8	...	305	53	...	5,807	2,130	7,937	

* Surveys executed by the Forest Survey Branch; the other surveys are by the Survey of India Department, and the areas have been taken from a statement furnished by the Surveyor-General.

SURVEY YEAR.	BENGAL.			NORTH-WESTERN PROVINCES AND OUDH.			POUNJ.		CENTRAL PROVINCES.		BUTMA.		ASSAM.		BIHAR.		MADH. PR.		BOMBAY.			By Forest Survey Branch.	By Survey of India Department.	TOTAL.
	Scale.			Scale.			Scale.		Scale.		Scale.		Scale.		Scale.		Scale.		Scale.					
	4"	2"	1"	12"	6"	4"	4"	1"	16"	4"	4"	2"	8"	4"	2"	4"	8"	16"	4"					
Brought forward.	151	..	..	3	169	2,831	208	468	..	230	1,065	319	..	..	981	1,218	8	..	398	53	5,807	2,180	7,987	
1888-89	..	215	..	..	..	38	..	215	..	339	..	162	..	..	..	..	3	..	..	..	682	..	2,128	
1889-90	..	..	..	..	..	159	..	58	..	..	308	..	162	..	..	..	..	108	..	22	..	1,576	..	2,723
1890-91	..	..	..	..	..	41	..	198	302	70	419	..	..	..	..	..	..	214	..	335	168	1,683	..	3,440
1891-92	..	..	..	..	..	46	..	47	..	108	468	169	..	150	..	..	..	..	..	19	124	1,586	..	3,566
1892-93	..	..	..	..	..	..	35	..	..	..	461	187	204	..	307	..	..	406	..	22	..	1,804	..	4,031
1893-94	..	..	..	..	..	..	..	..	..	149	477	128	..	..	..	..	..	..	..	40	195	2,270	..	4,276
1894-95	..	..	..	..	..	231	..	107	..	..	483	276	68	126	..	..	..	659	..	22	220	1,898	..	4,510
1895-96	..	..	..	..	..	..	..	123	287	111	897	246	144	..	..	..	..	788	..	185	232	2,377	..	5,088
1896-97	..	..	..	..	..	366	..	194	..	146	665	242	..	..	..	..	..	..	..	65	202	1,720	..	4,444
1897-98	..	..	..	..	..	473	..	239	..	..	712	271	..	..	..	..	..	881	..	235	202	2,555	..	4,910
TOTAL	613	215	3	215	4,982	205	2,965	3,942	1,255	11,471	5,433	1,386	613	936	1,221	5,118	192	2,313	3,095	22,641 (a)	23,518	46,159 (a)	46,159	
	867																							

Surveys executed by the Forest Survey Branch; the other surveys are by the Survey of India Department, and the areas have been taken from a statement furnished by the Surveyor-General.

(a) Includes an area of 3,942 square miles on the 1" scale surveyed for topographical purposes.

In 1889-90 it was decided to provide for the recruitment of the superior staff of the Forest Survey Branch through the Survey of India Department, and the Superintendent and his assistants were absorbed in the general cadre.

Year by year it became more evident that a survey branch, specially organized, controlled and handled for the kind of work required by the Forest Department, worked at a very much smaller cost-rate than a new party freshly introduced to forest surveys. As a matter of fact this is the history of the Forest Survey Branch itself. At the outset its work was expensive, even more so than that of the Survey of India Department, but as experience was gained the cost-rate diminished rapidly and in whatever province (Punjab, the Central Provinces or Burma) the Forest Survey Branch worked side by side with parties of the Survey of India, the cost-rate per square mile of the former was invariably much less than that at which the latter turned out their work, the difference averaging nearly 40 per cent. It thus became evident that arrangements must be made by which a certain section of the Surveyor-General's Department should be made permanently available for forest surveys, and it was decided to constitute a branch of the general department as "Forest Surveys of India," and to organize it somewhat on the lines of the present Forest Survey Branch,

which under this plan became absorbed in the Survey of India Department.

So far the programme has only been given effect to in the provinces directly under the Government of India, where the Forest Survey Branch has been amalgamated with Survey of India parties employed on forest surveys; but it is contemplated to extend the scheme to the Madras and Bombay Presidencies as well. The Surveyor-General will be in professional control, but the Inspector-General of Forests will, in consultation with Local Governments, decide what surveys shall be executed, on what scale and with what degree of detail. He will also examine and criticize the annual budget for the surveys executed under his directions. Mr. Reynolds has been entrusted with starting the new programme and the time of his service has, for this purpose, been extended till October 1900.

Working-plans.

The advisability of a systematic working of the Indian forests had frequently been urged during the earliest days of Forest administration, but until Mr. Brandis arrived in Burma no practical steps whatever were taken towards this end. Mr. Brandis set himself at once the task of ascertaining, by means of numerous linear valuation surveys, the available growing stock in the forests under his charge, and trained his assistants, both Europeans and Natives, to assist him in the work, and on the basis of the estimates thus framed and of the analysis of the

rates of growth on numerous stumps and logs, he calculated the annual possibility and framed preliminary working-plans. They were naturally plans drawn up on somewhat general lines, but they were prepared with extreme caution and hardly ever erred on the side of over-exploitation. These plans were our accepted guides for many years after Mr. Brandis had left the province, and were deviated from only when more detailed enquiries proved that any particular forest tract was able to produce a larger yield than had previously been accepted. During the first years of Mr. Brandis's Inspector-Generalship the preparation of preliminary working-plans in other provinces devolved to a great extent again on himself, and a few years later to some degree on Dr. Schlich and myself as well. Gradually, as more professionally-trained officers became available, the collection of *data* and the preparation of working-plans were undertaken in a more systematic manner in the various provinces, principally in the North-Western Provinces, Burma and the Punjab, but no regular system existed for the preparation of such plans, and there was no recognized control ensuring that the provisions of accepted plans would be permanently carried into effect.

At the outset all forest receipts and charges were Imperial, and the officers of the department were on one general list. The Local Governments had thus no direct financial interest in the working of the department, and the

officers looked to the Inspector-General to bring their services to the notice of the Imperial Government. Thus a fairly efficient control was maintained through the Inspector-General of Forests. In 1882, however, the department was decentralized, and the Local Governments obtained a direct interest in the surplus produced from their forests, and the officers who made it were praised. Then it became a matter of difficulty to restrain the working of valuable forest property within the limits of its permanent possibility as laid down in the preliminary working-plans. In the valuable *sāl* forests in Oudh the annual outturn was actually forestalled for many years, and even where no over exploitation took place, as for instance in departmentally-worked forests in Burma, the local officer, myself at the time, was suspected of a tendency to over-fell. As a matter of fact, I was in possession of a more efficient and energetic staff than my predecessors, comprising such officers as Messrs. Hill, Oliver, and Popert, who have all made a name for themselves in the annals of forestry in India, and we gleaned the forests of dead timber that had been left behind, and removed mature trees from the narrow bands between the paddy fields, and only increased the outturn from reserves, when detailed enquiry proved this to be admissible.

However this may be, the fact remains that the Government of India had fallen out of touch with the exploitation and management of

the various forests. It was then that Dr. Schlich, who was Inspector-General at the time, conceived the idea of centralizing the control of the preparation of regular working-plans, and of the future forest management under their provisions, and obtained the sanction of the Government of India to his plan in 1884. This was one of the epoch-making events in our forest history. The Working-Plans Branch, which up to this time had existed merely in name, was made a reality, and the powers of control which remained vested in the Inspector-General of Forests were greatly increased. The preparation of working-plans continued to be carried out by local agency and under orders of the Local Governments, but under the technical advice of the Inspector-General of Forests, who even after completion criticizes each plan and submits it to the Local Governments with a recommendation or otherwise. The Local Governments accept the plans and sanction them if they think fit. Provision was made for cases in which Local Governments disagreed with the instructions issued by the Inspector-General of Forests, for a decision by the Government of India. In spite of this, the policy of giving the Inspector-General of Forests such large powers of indirect interference with provincial forest management was severely attacked, but the Government of India remained firm, and wisely so. There have been but few differences, and in no single instance has the Government of

India been appealed to. The machinery worked as smoothly as could be desired, and the Government of India, through the Inspector-General of Forests, obtained all the control required over the forest management in the various provinces comprised in the Bengal Presidency.

The progress has been as great as could be expected with the number of officers available for the work. By the end of 1884-85, only 109 square miles were worked under regularly sanctioned working-plans. In 1886-87, this area had risen only to 329 square miles, but by the end of 1897-98 it had increased to 16,536 square miles, and in July 1899 comprised about 20,000 square miles. The above figures only refer to the Bengal Presidency, where at present about two-fifths of all reserves are worked under regular detailed working-plans. In Bombay and the Madras Presidencies, the preparation and control of working-plans is entirely local, and there is no technical adviser beyond the Conservator who submits the plans. In the Bombay Presidency, regular working-plans existed at the end of 1897-98 for 2,484 square miles, and were under preparation for an additional area of 3,514 square miles. In the Madras Presidency the staff has been too much occupied with forest settlements, and, as regards working-plans, a commencement has but lately been made. At the end of 1897-98 plans existed for only 201 square miles, but were under preparation for another 1,101 square miles, and

may now be expected to increase rapidly. A map is appended showing the progress made in the preparation of working-plans up to the end of 1897-98.

Similar progress has been made in the character of our Indian working-plans. Some of our earlier plans were over-elaborated, the principle of the weakest link in the chain had frequently been overlooked, and enumeration of the young stock and sometimes of inferior kinds of trees had made them too costly in time and money in comparison with their final prescriptions. The plans, however, which have been prepared during the last eight years are well balanced and practical in every respect. In the Bombay Southern Circle, however, a tendency seems still to exist to carry out the preliminary work in too great detail.

Experience has proved the wisdom of centralizing the control of existing working-plans in the provinces under the Government of India. At the beginning, especially when a change of officers had taken place, deviations from the provisions of such plans were the order of the day, and were more frequently, than not, carried out without the sanction of the Local Government or even of the Conservator, who under the Forest Department Code is permitted to sanction certain changes. Often such deviations were not even reported, but they were necessarily found out by the Assistant Inspector-General in charge of the Working-Plans

Branch in the Inspector-General's office, and were promptly brought to the notice of the Conservator or the Local Government; explanations were called for and the authority required for any deviation that might have taken place. By a strict adherence to this policy on the part of the Inspector-General of Forests, the necessity of the due observance of the provisions of regularly sanctioned working-plans was gradually recognized, and there is now little to find fault with in this respect. Though, however, the control is now much easier than it was at the outset, the increase in the number of working-plans much more than counterbalances this, and the examination of the annual control forms throws a great burden on the Office of the Inspector-General of Forests which year by year becomes a heavier one. It may at some future time become advisable to decentralize the control or to appoint another gazetted officer to assist the Inspector-General and to materially increase his office establishment.

The possibility of deviation which circumstances may render necessary or advisable has been fully recognized, and ample powers have been conferred on local Conservators to meet it. The rules on the subject stand at present as follows :—

“ As regards deviations from an approved working-plan, not amounting to a revision of the general scheme of management, exploitation in deficit (either as regards material or area) may be permitted on the order of the

Conservator, who will, however, subsequently report results to the Local Government, and, in cases where the deviation from the provisions of the working-plan is considerable or continuous, obtain the sanction of the Local Government thereto. The previous sanction of the Local Government should, in every case, be obtained when it is proposed to exploit in excess (either as regards material or area)—provided such excess is not caused by the accumulation of balances due to deficit exploitation in previous years—or when it is contemplated to change in any way the character of the exploitation. Conservators may act in anticipation of the Local Government's sanction in the case of fire or other serious accident, or in case of exceptional seed-years, necessitating a sudden change in the plan. Copies of the orders of the Local Government sanctioning such modifications should be forthwith forwarded to the Inspector-General of Forests."

The Inspector-General is assisted in the work of control by the Superintendent of Working-Plans, who is also Assistant Inspector-General of Forests, who is, for special qualifications and merit, drafted from time to time from the various Provincial Lists. The following officers have served in this position:—

Mr. J. W. Oliver (Burma List), now Conservator of the School Forest Circle and Director of the Imperial Forest School.

Mr. R. H. C. Whittall, died as Conservator of the Punjab.

Mr. E. P. Dansey (North-Western Provinces List), Conservator, Central Circle, North-Western Provinces and Oudh, now on furlough.

Mr. E. E. Fernandez (Assam List), now Officiating Conservator, Central Provinces, Northern Circle.

Mr. W. E. D'Arcy (Punjab List)—author of a valuable treatise on Working-plans—died as Conservator of the Central Circle, North-Western Provinces and Oudh.

Mr. J. L. Pigot (Assam List), now Conservator of Forests to the Mysore Government.

Mr. C. G. D. Fordyce (Bengal List), officiated during a three months' vacancy.

Mr. F. Beadon Bryant (North-Western Provinces List), for $3\frac{1}{2}$ years.

Mr. G. S. Hart (Punjab List), officiated during a three months' vacancy.

Mr. J. H. Lace (Punjab List), since 22nd February 1900.

*Communications and
Buildings.*

As in most other forest-growing countries, a large proportion of our Indian timber is conveyed by water, and we have magnificent water-ways in all our large streams, especially in Burma, Assam and Bengal. Many of our hill torrents also are efficient floating streams and carry our outturn of pine sleepers and scantlings to the plains. However, many of our Indian forests are landlocked and are only gradually being connected with the main transport lines of the country.

It is a well recognized fact that the greater part of the price paid by the consumer for timber and other forest produce is represented very frequently by the cost of its transport, and that it is consequently the duty of the Forest Department to facilitate this as far as possible. It is also acknowledged that the State

shares in the advantages gained by improved means of communication, in obtaining better prices for the raw products of the forests, and in many instances by making them saleable at all.

In addition to improved means of communication, rest-houses had also to be provided in the forests to shelter forest officers from the inclemency of an Indian summer and the rains of the monsoon: quarters had also to be built for the executive and protective staff.

All these works are so scattered that the only possibility of gauging the progress made is by the expenditure under this heading.

Before 1880-81 the approximate expenditure on communications and buildings amounted to $\text{R}1,30,000$ per annum, or 2.23 per cent. of the gross revenue. From then till the end of 1884-85 the expenditure averaged $\text{R}2,30,000$, and the outlay on communications and buildings amounted to 2.48 per cent. of the gross revenue. From 1885-86 to the end 1897-98 the expenditure averaged $\text{R}3,47,000$ per annum, amounting to 2.28 per cent. of the gross income. During the last six years, however, the expenditure has risen a little more rapidly; but even in the last year under review it only amounted to $\text{R}4,85,000$, or 2.73 per cent. of the gross revenue. This can hardly be considered sufficient, and a larger outlay would probably prove remunerative from the outset; but there is too much work of other kinds, and

the Forest Department have till now restricted themselves, as a rule, to the most important works connected with immediate exploitation. A vast field for their energy is still before them, but the work cannot be rushed and careful enquiries must precede the expenditure of money. Moreover, the system of major export lines, such as railways and metalled roads, is still constantly developing, and good feeder-roads, which would connect our forest road system with the main arteries of traffic, are only slowly advancing.

Forest tramways are as yet used to a small extent, only 30 miles being employed throughout the Empire. As regards roads, the North-Western Provinces and Oudh are furthest advanced with a complete system of cart-roads in the Oudh Circle and a good net-work of similar roads in the Central and School Circles. In Berar also considerable progress has been made, and the once almost inaccessible Melghat forest tract has been opened out. This was done by Mr. Bagshawe, the present Conservator, an excellent road engineer, who is also closely connected with the system of fine hill roads in the North-Western Provinces, most of which were made—when Captain Greig was Conservator—by Messrs. Bagshawe, Wilmot and Colonel Campbell.

Some other measures taken for facilitating exploitation deserve mention, amongst them the blasting and regulating of floating-streams and

the construction of slides. The regulation of floating-streams in Burma has been constantly proceeded with ever since it was started by Dr. Brandis, and much good work has been done in this connection. The lessees, especially the Bombay-Burma Trading Corporation, have done a great deal in this respect, from self-interest no doubt, but the State inherits the improvements made.

Considerable attention has been paid to timber slides, mainly in the Himalayas. The most important as regards size has been the Bakani slide in Chamba, which was planned by the writer and constructed by Mr. McDonell, now Conservator of Forests, in Kashmir, by means of which full sized logs, containing up to 365 cubic feet each, were sent to the floating river, a distance of 3 miles, from an otherwise perfectly inaccessible forest. Smaller in construction, but of great length and extremely remunerative, are the sleeper slides in the Jaunsar forests in the North-Western Provinces, the earliest of which were built when Captain Greig was Conservator of the present School and Central Circles in the North-Western Provinces.

The general protection of the Indian forests *General protection* was, at the very outset, a matter of great difficulty, as the people has first to be taught that causing injury to a forest constituted an offence ; for, as already explained in previous pages, people in olden times not only took what

they required, but destroyed forests and forest-growth unchecked. Thus in Burma, for instance, it was quite usual to fell a tree in order to collect leaves for cigarette wrappers. Areas amounting to thousands of square miles were everywhere annually destroyed by axe and fire for the sake of reaping one or perhaps two, often precarious, crops of cereals sown in the ashes; cattle and even goats grazed unchecked, and forests were fired to provide more extensive grazing grounds. Boundaries of forest property, though frequently shown on the maps and sometimes indicated on the ground, had no practical meaning; and the forest inside the boundaries were maltreated in the same manner as those outside. These abuses, which were dear to the Indian raiyat and clung to with the tenacity and ultraconservatism of the peasant, had to be stopped and regulated in order to make practical forest conservancy possible. The question of general forest protection, or forest police, has caused more ill-feeling and misunderstanding than any other part of the Forest Administration. On the one side was found the over-zealous Forest Officer who, from the day the forest was made over to his charge, wished at once to protect it with strictness; and, on the other hand, the sometimes over-sentimental District Officer, desirous of being the "*ma-bap**" of his people. These of course are extremes, but they existed and may

* Sole parent—father and protector.

still be found here and there. On the whole, however, matters regarding the general protection on forest have reasonably developed, much more so than could have been expected at the commencement. Less friction has naturally been caused in provinces where large forest areas permitted of a more gradual introduction of strict protection. It has been usual in annual reports to gauge the success of forest protection from tables exhibiting the number of cases regarding forest offences taken into Court, as compared with the number of convictions obtained, and the number of cases voluntarily compounded with the Forest Officer under the provisions of the Forest Act. This no doubt conveys a proof that the people are not, as a rule, unnecessarily harassed by Forest officials; and considering how difficult it is to bring a forest offence home to the culprit, the percentage of convictions, now amounting to 81 per cent., is sufficient evidence of the leniency and carefulness at present exercised by the Forest Administration in this respect. The true gauge of an efficient protection, however, is the present state of each individual forest, and on this point it is impossible either to tabularize or generalize. It may, however, be said that, on the whole, protection against forest offences is much more effective now than it was some years ago; and when we find that the productive power of Government forest property is on the decrease or is not

improving, the reason for this is generally not attributable to want of protection, but to be found in the exercise of rights awarded in excess of the potential capabilities of a forest, or in the rapid growth of undefined privileges. Both of these are contrary to the forest laws, but they are in places still allowed to occur.

*Protection from
rust.*

Fire-protection is the most difficult problem the Indian Forest Administration has to deal with. The nature of the climate favours the spread of fire, and during the hot, rainless season the forests are filled with dry leaves, herbs and grass, and become as inflammable as tinder. A spark, and the country-side is ablaze. This is bad enough, but we foresters here in India have not merely to deal with fires which owe their origin to accidents, carelessness or crime, but have to fight against an immemorial custom of the whole people, *viz.*, that of firing grass lands and forests all alike, in order to clear away rank vegetation and to make place for a new grass crop; and once lit, the fire is allowed to spread wherever it finds nourishment and wherever the wind may carry it. *Kumri*, *jhum*, *khil*, and *taungya* cultivation differing only in name in the several provinces by which a plot of forest growth is felled and burnt to make place for one or two seasons' crop of cereals—though entirely stopped in several provinces, is still practised to some extent throughout a large portion of the Empire, and as a rule no precautions are taken

against the spreading of the fire. Exceptions to this are found in the *Karennee* hills on the *Thoukyegat* in the north-east of Burma and in the Garo hills, where the people themselves are most careful to protect their uncultivated *Thumed* areas,—called *Poonzohs* or *árv*—from fire. Cases where fires spread from the land of one village to that of another, are as a rule settled by the payment of large fines, but have frequently led to sanguinary frays. An incalculable amount of good has already been done during the last 10 or 15 years by the gradual prohibition of *Kumri* cultivation; and at a low estimate forest which was formerly razed to the ground once every 15 or 20 years is now permitted to grow up on 5,000 square miles within the Government forest property of the Central Provinces alone. Though, however, saved from entire periodical destruction, the areas are still overrun by forest fires. These, in certain provinces almost general, conflagrations are the chief reason of the barren character of so many of our Indian Hill ranges, and are more closely connected with distress and famine than is usually supposed. Their influence is more hurtful in proportion to the dryness of the region in which they occur. This state of things is of course incompatible with increasing civilization, and cannot continue long; for the people, whose property is damaged by such conflagrations, will sooner or later seek the protection of the Courts—a

protection which at some future time will probably be impossible to withhold even from right-holders in Government forests. Forests and waste lands, with the exception of reserves and protected forests and village forests constituted under the Act, are at present practically unprotected by the law of the country, and it will soon become a matter for consideration whether the special circumstances in this respect will not necessitate special and more extensive measures.

In the early days of forest administration another great difficulty was a most marvellous, now almost incredible, apathy and disbelief in the destructiveness of forest fires. It was argued that forests exist and produce marketable timber which from time immemorial have been overrun by jungle fires. This could not be denied, and it was useless that the forest officers preached that the forests were deteriorating gradually, and pointed to the numerous treeless bamboo jungles and grass savannahs. The people would not believe that the majority of these areas had been once forest-clad.

It takes a long time before a mixed deciduous forest in India is entirely eradicated. Amongst the numerous species of which it is frequently composed, there are many which have a thick bark, a tough life, and a marvellous power of resistance against fires. After a fire has swept a few times over the forest, the

compactness of its canopy gets destroyed and each successive fire leaves it more open. This being the case, the danger is reduced to a ground fire, which cannot touch the crown of the trees, between which the interspersed dead trees glow year after year like a torch till they are gradually consumed, doing but little and constantly less harm to their wider and wider disconnected neighbours. As time goes on the process of destruction becomes thus slower and slower, but the end is none the less certain.

When the Forest Department came into existence, the great majority of the forests in India, excepting, of course, the evergreen jungles and tracts which for some reason or other were self-protected from fire, were in an extremely poor condition, open and interspersed with grass blanks, large areas frequently containing no tree-growth whatever. Many are still in the same state, and some have even gone further backward, because of the impossibility of extending fire-protection more rapidly than has been done.

Where the whole country-side is ablaze each hot weather, it is only by isolation that certain areas can be protected. The work was started in Madras about 1860, but the records are incomplete and perhaps refer only to the Nilambur plantation and some other selected portions. However that may have been, the work did not progress, and as late as 1882 we only find 300 square miles under protection, and in our

forest records we are accustomed to look at the protection of the Bori forest in the Central Provinces, as the first practical solution of the problem on which all future extensions were based, with such modifications as the conditions of the forests and undergrowth rendered advisable. Bori is also one of our show places representing an entirely restored forest, which must convince the most sceptical of the advantages of continuous fire-protection at any cost.

Major (now Colonel) Pearson's name is for ever connected with that admirable piece of work. Captain (now Colonel) Doveton, Major Pearson's successor, extended fire-protection in the Central Provinces with the greatest energy and success, and reduced the cost of the operations to a minimum. In the meantime Major Pearson introduced the same methods in his new charge, the North-Western Provinces. In Bombay also fire-protection was taken up fairly early and nearly 7,000 square miles are reported as protected in 1881.

Though the work was practically taken in hand only in 1865, 11,000 square miles of forest land were at the end of 1880-81 artificially protected from fire; by the end of 1884-85 this area had been increased to 16,000 square miles, and is now 32,000 square miles.

On the one side this gives, however, a more favourable view of the question that is really the case, for the success of operations varies

considerably, and areas saved one year may be burned over in another; but on the other side the fact must not be lost sight of that the area under the control of the Department contains much forest which is protected by its own natural conditions.

The forest laws give sufficient power to protect our reserved forests from fire, and are sufficiently stringent even in the case of protected forests, but do not affect the open jungles, which frequently abut on more valuable forests. These may be burned unrestrictedly, and are a cause of great danger to forest areas which it is desired to save. It is therefore evident that only those areas which have been artificially isolated by fire-lines and outward burning enjoy a sufficient legal protection. It is under these circumstances a noteworthy fact that in several localities a gradual change is taking place in the regular institution of firing the waste lands, especially where grass is valuable. The power of the general Civil administration of the country is also year by year more actively directed towards the prevention of forest fires, and on the whole the progress made in this direction is sound and steady.

Annual statements are prepared which show the progress and cost of fire-protection in the various provinces. They are very interesting and instructive, as showing the advances made year by year, but useless for comparison of

the work in the various provinces, for it is very obvious that it is almost impossible to *correctly* compare the results of fire-protection in any *two* forests even, the difficulties in the two being probably so very different—the length of the fire season varies, the number of dewless nights, the force of the wind, whether variable or constant, and the hours of the day or night that it blows; the facilities for procuring assistance, the presence or absence of forest villages, the good-will of neighbouring villages, the existence of rights of grazing, of collecting minor produce; the existence of main highways of traffic through or near the protected area; the length of boundary and fire-lines; the way the lines run, whether along cultivation or along open forest, whether cut in forest or in the open, whether consisting of streams or ridges, roads or cut lines; the scarcity of water, the dearness of provisions, the value of the labour obtainable, and many others which will occur to any forest officer. The return lately prescribed and submitted in abstract in the annual Reports, analyzing the origin of forest fires, is very useful, for it shows at a glance where the chief dangers lie in each forest and thus facilitate them being met.

Some provinces, however, notably Burma, are still somewhat backward as regards fire-protection. No doubt the difficulties in these localities are much greater than in others where we have been more successful, but my parting

advice is to extend fire-protection wherever feasible. Such extension, however, must be effective; the taking up of new areas beyond the power of the establishment to deal with often leads to the burning of a larger percentage than before and is worse than useless.

The annual cost of fire-protection is at present a little above R3,00,000, and amounts to less than 2 per cent of the gross revenue. There is no question that this rate of insurance is much too small, and I trust it will double itself before many years have elapsed; but we are handicapped by the amount of supervision we can afford for this important subject. As it is, the fire season is the most trying part of a forester's life, from the Divisional Officer down to the lowest Fire-Guard, and nobody who has not lived through it has any conception of the hardships it entails.

The work begins comparatively early in the season with the cutting of grass, herbs and bushes over miles upon miles of fire-lines, and even at this early period the work has to be constantly inspected to see that it is thoroughly done. When this material has become dry enough to burn, a most anxious and responsible time begins, for it has to be burned without causing damage to the neighbouring forests, chiefly at night when the dew has moistened the standing grass and when sparks can be more easily seen. This work becomes more and more dangerous as the season advances, and as the

surrounding jungle gets drier and more inflammable. It is at night only that the work can be safely done, and night after night the fire-gangs have to be at work. Then comes a short period of comparative ease, when the fire-lines are finished and the surrounding country is not as yet ablaze. Soon, however, the sky is red at night with grass-fires and fires in private and unprotected forests, and clouds of smoke wreath the horizon in the day time. Now everybody has to be on the alert, the surrounding jungle has to be burned outward when fires from outside approach the fire-protected forests and the belt of safety is not sufficiently wide. In spite of every precaution, the fire is sometimes carried into a protected forest area by the wind and then a fight begins, and compartment after compartment is defended till the fire has been got under. Such a fight is often very protracted, and what that means under the blazing sun of April and May, followed by a stifling night, can only be imagined by people who have lived in the tropic plains of India and can be realized only by actual experience. It is needless to say with what sense of delight the forest officer out here greets the first showers of the monsoon and sees his fire-traces covered with green sprouts of new vegetation.

From an administrative point of view it has to be considered whether fire-protection really repays the outlay incurred and all this trouble and exposure. An opinion expressed to the

contrary is now a very rare occurrence. A few years ago I might still have been tempted to give detailed examples of the beneficial influence it has had on the general aspect of forests of all classes and on their regeneration, but evidence of this is now plentiful and to be seen in all directions, and the necessity of making converts of either individual or public opinion has ceased. A few general remarks on this subject will naturally appear in the chapters on "Aboriculture" and "Sylviculture." It is, however, not only the tree-growth which has so largely benefited by the protection afforded, but the supply of grass and fodder has increased to an even more considerable extent. This is of considerable advantage to the surrounding agricultural population, and that its value is appreciated, when once understood, has already been shown by a few isolated cases, where the villagers in the vicinity of fire-protected forests have turned out *en masse* and unsolicited to protect Government forest property against approaching jungle fires.

The denser vegetation, which in almost every instance follows fire-protection almost immediately, has already had the most beneficial influence in counteracting erosion and preventing landslips and sudden floods, and the beds of rivulets debouching from fire-protected forests contract rapidly and flow in narrow and well-defined channels. A streamlet, the Mendikola, runs through the Mohwa Bir Reserve in Ajmer.

A few years ago it was thirty feet wide where it leaves the forest block, but since the catchment area has been protected against fire, the water-course has gradually been confined to a distinct deep narrow channel. Further below, where it is joined by small streams draining unprotected areas, the bed has maintained its original character. In the Central Provinces the smaller streams draining the Ahiri forests, which were broad and rugged water-channels, have, since the forests were protected from fires, entirely silted up, all but a narrow bed, and form part of the forest grown over with reproduction. The Sipna river (Bairagah Reserve, Berar), with its tributaries, which are crossed by the Ellichpur-Pili road, affords also a good example of the effect of fire conservancy in reducing floods, erosion, etc. Water-courses in the Siwaliks, between the Dehra Dun and the plains, have contracted to half, and even one-third, of their breadth under the influence of fire-protection. Many have entirely filled up and exist now only as gentle, partly-overgrown depressions. Last spring I had the honour of conducting Mr. Holderness, the Secretary to the Government of India in the Department of Revenue and Agriculture, through these forests and showed him that many channels, surveyed and mapped as late as 1876, had ceased to exist and were overgrown by bushes and young sal reproduction. In the case of the Ratamau basin, the sides and slopes of the hills are now clothed with grass

and young seedlings, and the water no longer rushes down carrying silt with it; the consequence is that the floods in the *raus* have been reduced in volume and force, the water-channels have become narrower and deeper, and the beds are stocked with grass and thousands of sisoo and khair seedlings. The little silt which is washed down is caught by the grass tufts, and the tendency is for certain banks in the bed of the stream to be raised, while the water-channels are deepened.

On the outer Siwaliks also fire-protection has had the most beneficial results, and the upper reaches of all streams, especially of the Dholkhand *rau*, have been confined into permanent beds, and the smaller torrents which existed but a few years ago have filled up and to a great extent already form part of the new forest springing up. That on this side of the Siwaliks no adequate effect has as yet been experienced in diminishing the freshets, which endanger the canal works, is due to excessive grazing in the lower reaches.

The influence of continued protection on the continuity and supply of water in springs, tanks and wells shows the most divergent results. In some places a continuity and regular supply of water followed in the footsteps of protective measures, whereas in others an immediate decrease of the water-supply took place. These phenomena were foreseen, and when the collection of water in a tank depends on a rapid flow,

like the collection of rain water from a roof, vegetation naturally interferes with this process. Time is, moreover, required before the sub-surface flow of water can regain its proper level, and our experiments in this respect are still too recent to give reliable results. Water has, however, already been found near the fire-protected Danta Reserve in Ajmer at a depth of 15 feet, whereas, under very similar conditions as regards rock, stratification and soil, but where the hill sides are barren, it is not reached under 25 feet.

*Grazing and
browsing.*

The nomadic and semi-nomadic habits of a great proportion of the people of India present another difficulty with which we, Forest Officers, here have to deal to an extent which can hardly be understood by our colleagues in Europe, and, worse than all, the grazing question is closely connected with forest fires.

From time immemorial the natives have grazed their cattle, sheep and goats on all waste lands and forests, wherever it suited them. Now it is a well-known fact that a forest in the most perfect state of production and reproduction can yield but a limited amount of grazing, and that a once ruined forest or an area under reproduction is even more sensitive in this respect. No doubt there is more grass in forests of the latter description, and tree-shoots are not so greedily attacked, especially when goats are excluded, but all the same the progress of restoration and regeneration is greatly interfered with. Nevertheless, we have to accom-

moderate ourselves to circumstances strictly protect as many forest areas as possible, and others during the most critical periods of their existence.

Since reserves were constituted, one of the most important questions has always been to fix the kind and number of cattle which had access to each forest area by right. In some instances these figures look formidable, as for instance in the Kulu settlement in the Punjab, where the total of the cattle grazing as by right within the reserves largely exceeds the number of cattle kept in the valley, but the same animals figure for different blocks and, generally speaking, I do not think it would, as a rule, have been a heavy burden on our forests or a puzzle to the forest administration to provide for this if matters had stopped there. However, it was decided, and justly so, that the extension of our forest reserves absorbed too large a portion of the customary grazing grounds of the country, and that they must yield fodder as well as wood.

The necessity of this cannot be gainsaid, nor the wisdom, though many a Forest Officer's heart may bleed that he cannot bring all his forests to that state of perfection, nor effect their regeneration as rapidly, satisfactorily, and completely as might be achieved if grazing were entirely excluded.

As a matter of fact in many parts of the country grass is in greater demand than wood, fires being, over a large extent of the country, needed for cooking purposes only, and for this

dried cowdung is generally preferred to wood, as giving a peculiar flavour to the food—an acquired taste, no doubt, but ineradicable.

Grass being a commodity largely needed, our forests must, to a great extent, be worked with this in view, and almost every working-plan is framed in accordance with the grazing requirements of the country.

Selected areas are entirely and permanently closed for the production of timber and poles, where such demand exists; others only for a certain number of years after exploitation, in order to ensure as good a reproduction of the forest growth as possible.

The periodical closing and opening are arranged for under working-plans duly submitted for criticism and sanctioned by Government, and the requirements of the people and the most necessary protection the forest growth needs are duly weighed and balanced. Where no working-plans exist as yet, the closing is arranged for under annual plans-of-operations. This is the only correct solution of the question, and great harm has been done by regulating the grazing in forest areas by general prescriptions and rules, instead of treating each forest on its own merits. Any such action robs the forest management of the necessary elasticity, without benefiting the public. It is in the interests of the State to utilize its forest property to the utmost of its potential capabilities, which cannot, it is clear, be increased by prescriptions

and records of undefined privileges, but which can be lowered past recovery by excessive use. Such records permitting privileges beyond the capabilities of the forest are only too frequently the consequence of the desire to secure the utmost benefit to the surrounding population, though in the end they effect the opposite. Larger temporary benefits can naturally be conferred if the capital is drawn on as well as the interest. The feeling that non-interference on the part of Forest officials with grazing should be secured to the people in Government forest property, is no doubt to some extent due to a reaction against the entire closing of forest areas made over to the charge of the Forest Department, which was originally attempted in some provinces.

This step was an unwise one. Of course it cannot be denied that grazing is hurtful to forest reproduction, and that the damage done is only a matter of degree, and that more especially regeneration is quite incompatible with the grazing of goats and other browsers. It is also beyond question that incalculable harm, and frequently almost incurable damage, has been done by excessive grazing, especially of goats, in the lower hills from which small streams and rivulets debouch direct on culturable lands below. Owing to the peculiarly friable nature of the sandstone formation of the *chôs* in the Punjab, the damage done in that instance is specially pronounced, and thousands

upon thousands of acres of fertile lands have been covered by sterile sand, owing to an unchecked grazing of goats and other animals. This is an extreme case, but the utterly barren condition and corrugated appearance of a large proportion of the hills in the Deccan, in many places in Madras and elsewhere, owe their origin to excessive grazing. The danger to which the canal works in the Saharanpur District are exposed is due to excessive grazing in the lower reaches of the *raus* of the Siwaliks.

Quite apart from the forest question, it is clear that the present way of dealing with these areas is wasteful from a fodder point of view, and more especially leaves no reserve in case of scarcity or fodder-famine. The formation of fodder and grass reserves to obviate those consequences was proposed some years ago. In my opinion no better reserves of this kind can exist than forest reserves, managed under working-plans framed with the purpose desired in view.

Large areas in the drier regions of India, especially in the *bars* of the southern part of the Punjab, are *bonâ fide* grazing grounds, and must always be treated as such in order to obtain the greatest possible yield. The maintenance of the wood crops in these regions is a secondary question. Such forests are closed against grazing for a few years after a wood crop has been gathered. But even here the exclusion of goats and camels has shown the most beneficial result. A failure of the rains

in these dry districts is at once followed by scarcity, and, if it continues for a few years, by distress.

In the Central Provinces, also, the income derived from grazing in forest reserves forms a large portion of the Forest revenue, and here it is found that the exclusion from grazing without resorting to fire-protecting at the same time serves no practical end, for, though reproduction takes place, a dense crop of grass almost immediately covers the ground; and conflagrations, which are the order of the day, sweep everything cleaner than it was before.

The aggregate and percentage of forest areas, both permanently and periodically closed, have constantly increased, and amounted by the end of 1897-98 to 33,738 square miles closed against all animals, and 28,146 square miles closed to browsers in addition.

It must, however, be understood that nearly two-thirds of the former area are represented by continuous forest tracts, chiefly in Burma, Bengal and Assam, and some other provinces in which there is no demand for grazing; and that no areas are closed, whether permanently or otherwise, without a deliberate and full consideration of the actual requirements of the people in the matter of grazing.

There is no fear that the burden will ever increase, for it has already been observed in several localities that a general advance in agriculture, which is doubtless taking place in

some parts of India, lessens the demand for forest grazing.

Fire-protection and closure against grazing have, on several occasions of fodder famines, proved a great boon to the country and saved the lives of many thousands of cattle. I would advise that in future years the returns showing the closure of forest areas should, under each head, differentiate between permanently and periodically closed forests.

Sylviculture.

Here in India it is necessary to rely almost entirely on the natural reproduction of our forests. For a more intensive management, the areas to be treated are by far too vast, and the average cash revenue per acre is too insignificant. The local demands are, as a rule, supplied free or at low rates; and rights or concessions, or the exclusion of large areas for the free supply of forest produce to the agricultural population, very frequently cause the utter absence or at least slackness of demand in the local markets. It is evident that, under the circumstances, the cheapest way of securing the continuity of the forests must, as a rule, be adopted, though an increased expenditure would frequently secure more rapid returns.

Even if the money was forthcoming, we have not as yet the necessary trained staff to supervise planting operations on a scale which would render the aggregate progress anything but insignificant, if compared with the large extent of forests in charge of the Department.

All we can, in the majority of cases, succeed in doing is to protect our forests as much as possible against fire, grazing and other harmful interference, and to exploit them in such manner as to give natural reproduction the best possible chance, and to assist the regeneration of the natural forests by such silvicultural measures as the circumstances of each case may demand. Such measures, under my interpretation of the word "silviculture," include all artificial help to effect the natural regeneration of the forests, as well as their after-treatment, in so far as this has the improvement of the *peuplement* in view. Under regeneration, such measures comprise, therefore, all such operations as the dibbling in of seed, and even such planting as has for its purpose the completion and improvement of the natural reproduction : under after-treatment are included the weeding and clearing of young forests, creeper-cutting and the killing of inferior trees interfering with the growth of trees of better kinds. Much has been done in this direction, and by continuous study of the condition of the various forests, the knowledge of the Indian forester as regards their respective requirements and treatment has considerably increased and is growing from day to day. Such knowledge as we may possess is brought to bear on the prescriptions of working-plans, a net-work of which is gradually being spread over the whole forest area. The science, however, of the

correct treatment of all classes of Indian forests is as yet in its infancy, and its study, I must say, looking back on the number of years I have been in India, of which a considerable portion has been spent within its forests, seems almost interminable.

I may be permitted to give a few examples of the difficulties we have to deal with.

We have evergreen, tropical forests, in which a luxuriant vegetation springs up as soon as the removal of the old forest growth admits sufficient light ; but, alas ! it is more frequently not the vegetation we want. Sometimes it is a dense crop of high grass, bamboos, plantains, wild ginger and other herbs and creepers, which result from an attack on the canopy ; at others a growth of species of an inferior kind : for even in the richest forests of this character, the real valuable trees are but sparsely interspersed. The treatment of forests of this kind, in view of the natural regeneration of the most valuable species whilst exploiting these, the only marketable trees the forests frequently contain, is perhaps one of the most difficult problems in forestry.

When advance-growth of the favoured species is found, mature trees of those species are removed, and those of other kinds are girdled independently of their age. However, advance-growth in these dense evergreen forests is, as a rule, only found when one of the old forest giants has succumbed or when by ac-

cident, or the interference of man, a blank has been created ; and so far the killing of other trees round parent trees of the better classes has but rarely had the desired results. Such operations have consequently not been greatly extended as yet, though, apart from creating large artificial blanks and of regularly planting them over, this method seems the only one which could be applied with any hope of ultimate success.

The deciduous forests, which luckily comprise the largest extent of our forest areas and the most valuable one, are easier managed and much better understood. They also, with few exceptions, of which the sâl forests are the most prominent, are not composed of one or a few species only, like most European forests, but consist of a great variety of trees, the majority of which are at present valueless, or at least unsaleable. The consequence is that though often it is a matter of no great difficulty to ensure reproduction in this class of forest by protective measures only, it is by no means an easy problem in Indian forestry to promote the production of the more valuable kinds and to prevent the deterioration in the character of the *peuplement* of the forests which, without special attention to this point, must, it is self-evident, result from the removal of parent trees of the more useful kinds only. In the treatment of the gregarious or more or less gregarious species, especially of *Shorea robusta*—the

sâl tree—we are now almost universally successful. We arrived, however, at our knowledge only by experiments, numerous failures and study. In many localities we suffered from spring frosts whenever we made our *coupes* too open and made thereby room for a dense grass crop—a great danger in this class of forests—which retarded natural reproduction sometimes indefinitely; in others where we kept the *coupes* too dark, we failed to obtain reproduction for want of light, and subsequent openings did not always have the desired results. However, *viâ media*, which varies of course in different localities, is now fairly understood, and even when the tree is found in admixture with *Terminalia tomentosa*—the sain tree—and some other species, we generally manage to increase the proportion of the more valuable tree in the crop of the future. The forests most difficult of treatment are those formed of a more or less compact mature crop. In some localities, such as the Garo Hills in Assam, the treatment is somewhat complicated by an undergrowth of bamboos. The tree is most grateful for fire-protection and protection against grazing, and it may confidently be asserted that the harvest of the future will be a much richer one than has ever hitherto been reaped and infinitely superior to that which the Department has gathered from many a half-ruined forest. I refer more especially to the forests of the School Circle of the North-Western Provinces, which

were in a terrible state when I first saw them in 1869-70, and which now form an almost compact pole forest, which must delight a forester's eye. I always like to show these forests to visitors, but majority of the non-professionals won't believe in their former ruined state. A very interesting monograph by Mr. Eardley Wilmot, on the sal in the North-Western Provinces and Oudh, is found in "Stray Leaves from Indian Forests."

The treatment of *Dalbergia Sissoo* and *latifolia*, *Acacia arabica* and *Catechu*, *Hardwickia binata*, *Xylia dolabriformis*, *Albizia Lebbek* and others when they are found gregarious and associated with but sparsely represented species of other kinds, offers, as a rule, no special difficulties when strict fire-protection can be afforded.

However, even as regards these species we have still much to learn, and the question, for instance, how to increase the natural reproduction of *Dalbergia Sissoo* and *Acacia Catechu*, on other but newly thrown up river land, still requires to be solved. Here again see in "Stray Leaves from Indian Forests" a monograph on Sissoo and Cutch in Oudh by Mr. Eardley Wilmot.

A great majority of our deciduous forests in almost all parts of India came to us in a ruined state. The big timber had been removed and continuous firing and hacking had left us a crop of ill-shapen, gnarled and often unsound

trees. The removal of the old crop as rapidly as this can be safely accomplished without unduly interfering with the productive power of the soil, in order to make room for a more vigorous new crop, grown under the benefit of fire-protection and grazing regulations, is clearly indicated. A considerable proportion of our working-plans deal with forests of this kind, and improvement felling is the standing dish. Naturally they are, in accordance with the conditions of each case, prescribed in all degrees of severity, from a gentle thinning out of the most useless trees, entailing but temporary interference with the canopy, on the one side to coppice under standards on the other. In the latter case we trust both to coppice and natural seedlings to recover the ground, and only seed-bearers of the best species and promising young trees are left. Moreover, it has been possible to afford continuous fire-protection and to regulate the grazing so as to give time for the new forest to spring up. The result of these operations has, in the comparatively few years during which a conservative treatment has been accorded to the forests, been generally satisfactory, and in many instances excellent to such a degree that the treatment may probably frequently be changed, after only one rotation of the existing plans, to more ambitious schemes. Even more or less denuded areas within the deciduous zone require rarely anything but seed, either supplied by natural seed-bearers or

by man, to ultimately re-clothe themselves with forest growth. In the Central Provinces, for instance, *Zizyphus* and *Ougeinia dalbergioides*, and in the driest portions *Boswellia thurifera*, spring up as soon as a denuded area has been protected and gradually make place for more important trees. In other localities trees of other species appear first, *Nauclea cordata* being always amongst the first in the moister deciduous forests in Burma. It may be laid down as a general rule that the trees which disappear last, if the destruction of the forest has been gradual, are the first to re-appear if protection is afforded. Remarkable also is the success of the broadcast sowings on previously almost barren hill-sides in the Poona District, Bombay Presidency.

The natural regeneration of our most valuable mixed forests containing some of our very best trees, and amongst them the king of all—the teak tree—is frequently very much more difficult. However, a considerable amount of careful study, energy and ability has been brought to bear on this question, and we may claim some sound knowledge and a fair amount of success as regards the treatment of these forests. We have to deal with various classes of these forests, in most of which, however, the teak and other valuable species form but a portion of the tree-crop.

We have, first, forests in which the tree canopy is comparatively open—very open in

most cases—but where the ground is covered by a dense crop of gregariously flowering bamboos, such as *Bambusa polymorpha*. Next, those in which the cover of the trees is as a rule somewhat closer, though by no means compact as a rule, mostly with an undergrowth of *Dendrocalamus strictus*. This class includes areas of large extent, chiefly in the Central Provinces, Berar and the Northern parts of the Bombay Presidency, where the teak tree appears mostly in the shape of a mangled, gnarled and cut about constituent of a poor ruined forest. Then, those in which the mixed tree-crop is fairly dense, and in which bamboos are either absent or represented by scattered clumps. Finally, areas in which the teak grows gregariously, which, however, are mostly of small extent and scattered.

Those large gregariously flowering bamboos, which form the undergrowth of the forests of the first class, are, no doubt, very useful in many ways; but in many localities a hundredth part would probably meet all requirements, and they are a terrible nuisance in respect of a regular tree reproduction. They afford shade, but I much doubt that they have otherwise any appreciable beneficial influence on the soil. It is only when they have flowered and died, and the dense cover of bamboo leaves is temporarily removed, that tree reproduction has the slightest chance of success. That this is so, is clearly evidenced by the age-stages, re-

presenting the existing forest growth being in general accord with the periods of the bamboo flowering. These periods of seeding are far between, and we have to wait for them in order to increase the reproduction of teak, as all other means we have tried to encourage its reproduction in the intervals between the flowering, though mostly successful, have proved to be by far too costly. The attempt made to kill the bamboos by repeated cutting down of the new annual shoots has failed entirely.

Advantage has already been taken in Burma of the occasional flowerings of the bamboo to extend the area under teak. The method now usually adopted was first introduced by me in 1880, with the help of Messrs. Popert and Oliver. The areas to be treated were first fire-traced and then, as far as possible, cleared by fire of the dead bamboo stems; the teak and cutch seed was dibbled in plentifully, and as many plants put out as were available. The success, though varying, has been generally good, and in many instances the young growth approaches in completeness that of a *taungya* plantation. The system can, however, only be applied where the existing young growth is poor enough to excuse its being sacrificed: otherwise the use of fire must be dispensed with, and the mere dibbling in of seed in areas over which the bamboo has died is not so certain in its results. The year before bamboos flower, the clumps produce no annual shoots,

so that arrangements can be made beforehand to meet the opportunity. Some 4,000 acres have since 1880 been stocked with teak in this manner, chiefly, however, in localities under *Dendrocalamus strictus*, which sometimes flowers simultaneously over considerable areas.

A flowering of *Bambusa polymorpha* of considerable extent is imminent in a year or two. This will place the method to a severe test, and it is hoped that fair progress will be made in extending the proportion of teak in part of the forests affected.

The treatment of those forests in which the more valuable trees, especially teak, grow over *Dendrocalamus strictus* is generally more satisfactory. To begin with, the shade of these bamboos is much less dense, permitting natural reproduction even when not in flower, and now and again a young teak tree manages to push its way through the cover over-head and, if not can be fairly easily assisted to do so. Next, the bamboo flowers more or less sporadically, and opening for young tree growth are constantly found in this way; and finally there is no fear that the young trees once established are in danger of being overhauled and topped by the young bamboos—an event which happens but too frequently in the case of the larger kinds of bamboos. Considerable success has been obtained in forests of this kind by dibbling in teak and cutch seed in places where the bamboo cover was somewhat open, either by accident or

due to sporadic flowering, and works of this kind can be carried on more or less continuously. In the more open forests in the Central Provinces, where the tree has not to the same degree to fight against bamboos and other quicker growing species, protection alone has sufficed to establish the teak tree as the dominant representative in a large portion of the forest area. The cutting back of the ill-shapen and damaged trees has, as a rule, resulted in a strong coppice, but seed-grown young growth is also plentiful. The protection of the teak tree, as a royal tree, in Bombay, has had a marked influence on its reproduction. The natural reproduction of *Acacia Catechu* in forests of this kind is also good, as soon as fire-protection can be afforded.

In forests of the third class, comprising those mixed forests in which none or but little bamboo is found, considerable success has been achieved by improvement fellings, consisting of the removal or girdling of the inferior trees surrounding parent trees of the better species, such as teak, pyinkado, cutch and others. The extension of similar measures to larger areas in Burma is now under consideration, and will no doubt be given effect to. In Berar, the Central Provinces and the northern portion of Bombay the method has for years been adopted.

Curious to say, in forests of the last class, composed of pure teak, we have met with quite unexpected difficulties in ensuring satisfactory natural reproduction, and whether this is due

to the heavy drip from the parent trees or other causes is as yet unsolved.

There can be no doubt that by the various measures adopted, the crop of the future has been considerably enriched in teak in all areas to which the Department has so far been able to give special attention, and the work is progressing from day to day, and future generations will in consequence reap a much richer crop.

In all classes fire-protection is unquestionably a *sine qua non* to complete success. The teak tree has a greater power of resisting the effects of fire than most other trees with which it is associated, and this fact has from time to time been urged against the necessity, or even advisability, of fire-protection when the growth of teak is the desideratum. The last attack on fire-protection, made by a practical and scientific man, led to more minute enquiries than had previously taken place, and one of its main features—that a larger amount of teak seedlings was found in constantly burned than in fire-protected forests—was entirely disproved. The number of small plants below 3 feet high was undoubtedly larger in the former than in the latter, an observation on which the whole argument against fire-protection was based; but most of these represented plants that had been burned down year after year and sprouted up again. There was a remarkable scarcity of larger young trees, and when all young growth

up to 20 feet high was counted, the number found in the fire-protected forests were several times more plentiful than those in the open forests.

The cutch tree (*Acacia Catechu*) though a most undesirable companion for teak in a young plantation and *taungya*, where all the trees are of equal size, knocking off with its hard, whip-like branches the new leaves and tender shoots of the former, form, in all but the first and last classes mentioned of teak forests, a most sociable and valuable companion of the teak tree. Much of what has been said of teak applies to this tree as well, and in its reproduction it is very grateful for protection and encouragement. In addition, it takes, in drier regions, possession of deserted fields much more rapidly than the teak tree can be expected to do.

The natural regeneration of ironwood (*Xylia dolabriformis*), and of the padouk tree causes as yet some anxiety, but the question is receiving all the attention which can be given to it. The main conditions of the padouk are the same as in the case of teak, the tree being but scattered in the *peuplement* of a mixed forest, but its exploitation on anything like a large scale only dates 12 years back, and the observations regarding its requirements are consequently as yet incomplete. However, of late some of its neighbours have, become of sufficient value to warrant their extraction, and this will much facilitate our operations with a

view to improve the percentage of the most valuable species in the forests of the future.

The same difficulties, as above noted in the case of the teak tree, the cutch and the padouk, become apparent in a greater or lesser degree as soon as a forest is worked for any other or a few valuable species only; but it would lead us too far to follow the different phases of their reproduction, even in the sketchy manner in which the subject has been treated as regards the teak tree. Moreover, the question has not been studied as yet sufficiently closely with regard to other valuable trees. It may, however, be generally noticed that mere protective measures have caused a vast improvement in the regeneration of the mixed deciduous forests.

Another extremely valuable tree, though growing under somewhat different conditions, which deserves mention is the sandal (*Santalum album*). Its *habitat* is confined to the drier regions of South India, chiefly to Mysore and the adjoining districts of Madras. It has been a royal tree for ages, and thus had every advantage of reproducing itself. However many of the open forests in which the tree is found, and the hedge-rows, are giving place to cultivation, and considerable difficulties are met with in the introduction of the tree into new localities. A monograph on this tree by Mr. P. M. Lushington will be found in "Stray Leaves from Indian Forests."

In the hill forests in the north of India, the deodar (*Cedrus deodara*) is the most important tree. It grows both gregariously and in mixed forests. In the former case its reproduction presents no more difficulties than that of the *Abies pinata* at home. At the outset many forests of this kind had been ruined more or less by the reckless fellings by contractors, and crops of *Indigofera* and brambles appeared on the scene. With this before us, the early fellings executed by the Forest Department frequently erred in the opposite direction, and a much longer time elapsed before some of our forests were regenerated than, according to our present knowledge, would seem necessary, and artificial aid had often to be given to make the cover complete. A peculiarity of the tree, only of late years first discovered by me, is that a considerable proportion of the species only bear male flowers year after year, which makes the selection of seed-bearers somewhat intricate, especially in a closely-grown mature forest with crowns high overhead, but it is in the end merely a question of accurate observation. A somewhat increased difficulty is experienced where the deodar forms a portion only of the *peuplement* of a mixed forest, especially where the intermixture is argely composed of the blue pine (*Pinus excelsa*) of the Himalayas, a tree which in youth and on deep suitable soil grows much faster than the deodar. I may, however, claim

for the officers of the Department that they know how to treat all forests in which the deodar appears to the best advantage. All we so far know as regards this is, I think, pretty well contained in my monograph on the deodar in "Stray Leaves from Indian Forests," and it would seem unnecessary to enlarge further on it in this paper, which is intended only as a general *resumé* of the progress of forestry in India.

Fire-protection, closure against and regulation of grazing, and correct silvicultural methods have, independently of artificial plantations, insured as regards this tree a far more extensive and richer crop for the future than that which we have reaped and are in the course of reaping.

The next point which I think it desirable to touch upon is the natural regeneration of the other pines in the Upper Himalayan forests—*Abies Webbiana* and *Picea Morinda* and the *Pinus excelsa*. As regards the latter, which is the most valuable of them, there is no difficulty at all. On suitable soil and under decent protection it grows like a weed as soon as sufficient light is admitted, and spreads on the outskirts of the forests whenever the area skirting it has the slightest rest from interference. As regards this latter point, the forests of *Abies Webbiana* and *Picea Morinda* show a similar inclination; but we find very great difficulties in attacking a mature forest of these species with fair results regarding their regeneration.

In most instances forests of this kind are as yet of comparatively little value, as it does not pay, until a further advance has been made in the impregnation of inferior pines, to exploit them for exportation of the timber to the plains of India. There are, however, certain areas in the vicinity of hill stations and cantonments, which by their situation are of importance. There is no shirking the question that in regard to these we have not as yet achieved sufficient success, and are, I am inclined to believe, living as yet to a certain extent on capital. The question whether it would not be advisable in the end to resort to clear fellings and replanting seems to draw near. I think it would be the most simple and practical solution of the question. The reproduction of the various oaks in the higher hills and of the mixed oak and pine forests is well understood, and almost invariably success in their treatment may be claimed.

At a somewhat lower level we come to the extensive areas of *Pinus longifolia* in the north, and *Pinus Kasya* and *Merkusii* in the south-east of the Empire. Their regeneration is very similar, and requires nothing beyond strict fire-protection and sufficiently open *coupes*. In the north of India, large areas are under protection and proper management, but many and extensive tracts, especially in the Punjab, are still exposed to conflagrations to which they are excessively liable, and in the Burma hills,

where the forests are very remote, inhabited by a *taungya*-cutting population, and as yet of little commercial value, fires still cut into them year by year and lessen their extent. This is a great pity, for perhaps no trees are so grateful for fire-protection, and whenever a few parent trees have been left, *Pinus longifolia* forests spring up on protected areas with almost incredible rapidity where reproduction was a few years ago almost at a standstill.

Of somewhat peculiar interest is the reproduction of *Juniperus excelsa* in the west of India. The tree, as it grows there, is very tapering, the timber is knotty and yields inferior firewood only, but it represents the main portion of the wood-supply of those arid hills. For years it was believed that no natural reproduction took place at all; but this is not the case, and a fair supply of seedlings is found under the shelter of the long, drooping branches of the parent trees, which almost sweep the ground. Naturally nothing can be done under such circumstances beyond insisting on a careful fire-protection and exclusion of grazing wherever exploitation takes place.

More frequently than of any other subject, I have mentioned that of fire-protection; but it is one of the most important in forest administration in India, and I have no hesitation in doing so once more. It has sometimes been stated, even by professionals, that fire-protection encourages the growth of grass to such an extent

as frequently to render tree-reproduction impossible. These gentlemen are in too much of a hurry, and no doubt a forester's life is lamentably short in comparison with the time it takes for the results of his work to become appreciable, but a natural development moves slowly, and, unless we are prepared to spend money on planting operations on a large scale, we must wait.

Under the influence of fire-protection, the growth of grass obviously becomes stronger during the first few years; but as the crop, if not cut, dies and decomposes every year, accumulation of half-decomposed rubbish gradually, and in some cases even rapidly, weakens the root-stocks, and each successive year the crop is lower and thinner than it was during the preceding years. Moreover, this accumulated rubbish and the existing root stocks, with their mass of root-fibres, prevent the appearance of any appreciable proportion of new grass directly from the germination of seed, so that the crop year after year comes up principally from the root-stocks which naturally grow weaker from old age. During the first year, however, as has just been said, the crop of grass becomes very heavy, and for the time being the reproduction of the forests is retarded. The subsequent natural weakening and thinning out of the grass is at best a gradual process, and in some localities may even be very slow, indeed, almost imperceptible, for a considerable number of years.

We may next consider the alluvial forests largely placed on the banks of the Indus. They are chiefly composed of *Acacia arabica* and tamarisk, and gain their life-blood from the overflow of the rivers. So long as this takes place, no difficulty is found in their regeneration; but when it is withdrawn by embankments, the forests wither and are either given up to cultivation under irrigation, or will in the course of time probably assume the character of the dry forests of that region.

This carries us naturally into the dry forest region. As pointed out in the early pages of this paper, the shading off of the deciduous forests into this class is very gradual. Experience has already shown, especially in Ajmer-Merwara, that ultimate success is almost certain to reward continuous forest protection even within this zone. In many parts of this area regeneration, though it may be slow and uncertain, is by no means hopeless, and doubtless many areas, as for instance in parts of the Deccan, are condemned to this class, because they have been utterly devastated by fires and grazing and would require perhaps a century of careful nursing before they would re-assume their pristine forest-clad appearance. In the same proportion as forest reproduction becomes slower and less certain in drier zones, it gets more sensitive to interference by man, fires, browsing and grazing, and requires,

if success is to be attained, a proportionately stricter treatment.

There are, however, dry forests in the centre of the dry zone and where it shades off into desert land, still containing an open bushy crop, with sometimes a fair amount of firewood per acre. About the origin of these and their final regeneration from seed we know practically nothing. All we know is that they have enormously long roots, which have been followed down to the depth of 70 feet without finding their end, and that they throw out coppice with great, and so far apparently undiminished, vigour. We rely on this and on their extent; but whether, and how long, the productive power may last is an open question. Fortunately they are economically of greater importance as grazing grounds than as wood-producing forests; and large areas thereof are so situated that, by means of the great canals the British Government have been and are making, they can be converted into rich wheat fields.

The littoral and tidal forests, of which the Sunderbans in Bengal are a typical representative, require no special care beyond certain felling regulations and a general protection; reproduction within them is superabundant both from seed, which is spread by the action of water, and from coppice. These forests are gradually moving out towards the sea, as is clearly evidenced by the existence of sub-

merged forests of this class far inland—in Bengal even to the north of Calcutta.

I feel as if I had only skimmed this important subject; but the very purpose of this paper prevents me from giving more than passing glances towards the commercially most important and otherwise most interesting forest areas, and I must leave it to other more competent pens to supply details and monographs of each special class of forest, for which purpose “Stray Leaves from Indian Forests” have been specially opened to them. I am unfortunately, and always have been, one of those forest officers described in a Madras letter, to whom the pruning knife and the rifle, and I might perhaps be allowed to add questions of practical forest treatment and administration, come more handy than the pen.

Arboriculture.

Arboriculture is doubtless the most effective and rapid measure to insure the regeneration of an exploited forest area and to change its character to a more valuable one; but it is obvious that the cost of sowing and planting must limit the extension of such operations to localities particularly favourably situated as regards forest growth and markets, where *arboriculture* may, for these reasons, be financially more remunerative than *silviculture* with its unavoidable delays; to denuded areas which for other reasons it is advisable to re-stock; or to areas situated near climatic extremes of forest growth, or where no parent

trees exist of the species it is desirable to propagate, or where the ground is covered by a dense growth of shrubs and weeds, or otherwise rendered unsuitable for the reception of seed.

Thus, in comparison with the vast forests under the control of the Department, the area of artificial plantations is insignificant, but taken independently they form a considerable aggregate. In the Bengal Presidency and Madras the returns of plantations do not include, as already noted, the artificial measures which have from time to time been taken to complete and improve the regeneration in natural forests, measures which have sometimes been of considerable extent, but in Bombay it is possible that cheap cultural operations are included in the returns. Areas, also, which have been sown and planted, but which, though not sufficiently successful to be classed as regular plantations, show nevertheless in many instances a decided improvement on the original forest growth, are excluded, as well as complete failures.

After these deductions have been made, the areas of plantations, recorded as successful, amount in round numbers to 100,000 acres, 68,000 in the Bengal Presidency, 20,000 in Madras and 12,000 in Bombay. This is an achievement of which the Forest Department may be proud.

The Nilambur teak plantation in Madras

deserves the first place, and special mention in all records of planting work, not merely because it is the oldest, but also on account of its enormous value as compared with its extent. It was started, as already mentioned, by Mr. Conolly, the then Collector of Malabar, as early as 1810, and the oldest portions will be mature in another 30 to 35 years. The planted area extends at present over upwards of 4,200 acres. This area is not everywhere equally well stocked. In fact, in some instances unsuitable soil has been cultivated, and the result has been a partial failure; but on about 2,100 acres the growth is remarkable, and is satisfactory on an additional 1,800 acres. Up to 1894, about ten-and-a-half lakhs of rupees had been spent on the plantation, but at that time the revenue realized had already overhauled the total expenditure. The gross revenue to be realized during the 10 years ending in 1905 has been estimated at somewhat in excess of Rs. 6,50,000. During this period the expenditure may still be estimated at 50 per cent. of the gross income, but this percentage will diminish year by year as the income increases. A forecast has been made that when the plantation becomes mature, at the age of 95, the annual income will reach upwards of half a million rupees. This estimate may probably be somewhat excessive, but the plantation is admirably situated for export, on the banks of a most perfect floating stream, and

the timber is but little less valuable in the forest than in the depôt.

Valuable regular teak plantations also exist in Burma, at Magayee, Kyetpaung, Bobenchoungwa, Kywémaking, Pyunchaung and Promé, aggregating 3,668 acres. Some portions of these date back to 1857, the time when Mr. Brandis had control of the forests of Burma. In the desire to place those established a few years later as near the market as possible, some areas were selected at Kyetpaung and elsewhere with not very suitable soil, but over 75 per cent. of the aggregate are established on good soil and the growth is as good as the average growth in Nilambur, the marvellous growth on alluvium being excluded. These plantations were very expensive. When it was found that in the real home of the teak, to which, though the situation was not so favourable as regards export, the planting operations had been gradually transferred, very much cheaper means existed of cultivating the tree on a large scale, the extension of regular plantations was gradually curtailed, and for many years past has been almost abandoned.

As far back as 1856, Mr. Brandis conceived the idea of pressing the shifting cultivation, as practised by the Karens, into the service of arboriculture by interplanting the crops with teak. This shifting cultivation, which is still widely practised over many parts of India, and which was at that period even much more

general, consist in the cutting down of the forest growth, firing it when dry and sowing the area thus prepared with field crops. When these have been reaped and, as the case may be, after two or three years' use, the area is deserted, and a new piece of forest is destroyed. This goes on till a forest growth sufficient to give a good blaze and plenty of ashes has grown upon the area first attacked. The rotation occupies from ten to thirty years. In Burma these clearings are called *taungyas*, and this name has been adopted in our reports and returns.

A Burmese Forester, Oo Tsan Dun, in charge of the Kabaung forest at the time, was the first who gave practical effect to the orders issued on the subject, and for some years continued to plant teak in the *taungyas* he cut and cultivated with paddy and cotton. The plantations, thus formed, were small, but the results were excellent, and the scheme was followed up, on a somewhat extended scale, by Mr. Graham, for some time Deputy Conservator of Forests in charge of the Toungoo Division. In 1868, however, the area thus cultivated amounted to less than one hundred acres. It was at that time contemplated to extend this method of cultivation to 350 acres per annum at a cost of R30 per acre during the first five years. However, for some years hardly any progress was made in the extension of teak *taungyas*, and by the end of 1872-73 the total area thus cultivated amounted only to some 250 acres. In 1873-74,

the then Conservator, Major Seaton, entered into agreements with many of the Karens in Tharrawaddy and Prome, and induced them to plant by the promise of definite *taungya* grounds. The result was that some 250 acres were planted in that year, and upwards of 300 in the year following. In 1875-76 the area planted had risen to about 1,050 acres. It was evident that the method of cultivation must be restricted to reserves and areas which could be effectually fire-protected. This for some years curtailed the expansion, and by the end of 1879-80 only about 2,500 acres had been planted out. By this time, however, reservation had been considerably extended and the population had become accustomed to the employment thus offered, which gave them a regular income, in addition to the crops which they were able to raise just as in former times; and it became possible to work over larger areas, and at the same time to command better average results. Even the uncivilized Karens had become aware that we were conferring a favour rather than seeking one, which had been their feeling at the outset. We also employ these men in girdling, timber works and other forest operations, and the disbursement of several lakhs of rupees per annum have transformed these tribes, who in former times hardly ever earned any money, from an antagonistic nuisance to forest conservancy into the most loyal servants of the Department.

This naturally could not have been effected in the same satisfactory manner without the settlements on the principle described on page 119. Thus the extension of *taungya* arboriculture rose in 1880-81 by upwards of 1,000 acres and went on growing till it culminated in 1897-98 in the planting up of 4,100 acres. The area recorded as sufficiently successful by the end of this year amounts to 52,000 acres.

The cost of these operations have up to date amounted to some seven lakhs eighty-eight thousand rupees, or R15 per acre, a sum which includes all weeding and clearing, but not thinning operations, which must sooner or later be taken in hand ; for, as in the case of deodar and many other species, the poles in a more or less compact young teak growth, such as found in plantations, do not get suppressed and killed out soon enough, and getting drawn up in the crowd prevent the full and early development of dominant stems.

This enormous annual extension of the teak *taungya* plantations is very satisfactory, and the productiveness of large forest areas has been greatly increased by these measures. Of course, there may be calamities such as fires and insects, but even discounting these, I think it may be safely assumed that the areas so far planted will, when mature, yield an annual supply of 30,000 tons of timber, and an income of seven to eight lakhs of rupees.

It has, however, been asserted, and I fear

sometimes on good grounds, that in the desire to bring very large areas within the scope of rapid improvement, the selection of the places to be cultivated has not, of late, been always entirely judicious and has included places where the tree is already sufficiently represented and where no impediments existed to secure its regeneration by means of protection and improvement fellings. Under such conditions, teak *taungya* cultivation is out of place. It may be advisable to curtail the wholesale extension of teak *taungya* plantations, and to divert the funds which thereby become available to protection and silvicultural measures. *Primâ facie* such plantations should be restricted to areas more or less under the influence of dense shading, gregariously flowering bamboos, and to such localities where the tree has been exterminated, care being taken not to try to extend them to areas where the soil and other physical conditions are unsuitable to the tree. For such localities the method was originally devised. In forests under cover of dense bamboo, no great apprehension need be felt about the occasional damage done to a few teak trees in a *ya*, or even about their destruction. It is, moreover, very difficult to judge from isolated trees left standing in a *taungya* what their chances would have been if the natural forest had been left standing, and even less can be told from stumps found ; but such observations have been used to prove the assertion that the *taungya*

cultivation had been injudiciously extended of late. Though some seed-bearers even may exist and grow up in gregariously flowering bamboo forests, the dense cover prevents all possibility of regeneration, except at long intervals during the period of flowering, and it will, under such circumstances, be better to create scattered compact well-stocked areas even at the sacrifice of a teak tree here and there.

Teak plantations were also established in Bengal and Assam. The most important of these is the Sitapahar plantation in the Chittagong Forest Division. It cost R70,000 and contained a fully stocked area of 600 acres, with a growth comparing with that of the best parts of Nilambur, but unfortunately it was established within the bed of periodically returning cyclones, and was practically entirely destroyed by one of these catastrophes in October 1897.

The teak plantations in Assam established between 1872 and 1881 are of smaller extent covering 170 acres. They are growing well and their extension in suitable areas should, I think, be considered.

The sissoo plantations in the Punjab deserve some special mention. They are partly established and maintained under a system of irrigation, and partly comprise those grown on areas where the subsoil moisture suffices for the purpose. Amongst the former the Changa Manga plantation is the most important and most

successful. The wooded area comprises 8,400 acres. It was established in the centre of the dry forest area, where the long rooted *bar* trees alone can exist, but is now, under the influence of irrigation, covered with a complete crop of *sissoo* and *mulberry*. The plantation was begun in 1866, but no success could at first be obtained. In 1868 Mr. Amery, then in charge, had the idea of employing a trench and ridge system. When I took over the division, though but a comparatively small area had been stocked, I felt convinced the correct principle had been ascertained, and within a few years the whole area was planted. The plantation has been a *sylicultural* and financial success, in spite of the high rate for canal water which is chargeable against it. Under the working-plan, it is treated as *coppice* with a few standards, and we are already occupied in reaping, the crop of a second rotation.

Most of the present plantations on *sailaba* land where the percolation from the rivers in their vicinity gives a special impetus to the growth of *sissoo*, were also established between 1867 and 1874. The growth of *sissoo* here is even better than in *Changa Manga*, and as there is no water rate to pay and no trenching to be done, the results have been financially much better.

No very extensive *deodar* plantations exist in the forests of the Western Himalayas. The artificial cultivation of the tree has, however, been reduced to a certainty, considerable

aggregate areas have been stocked and are increased annually by several hundred acres in accordance with pre-considered working-plans. The working-plan for the Mundali forest in the North-Western Provinces alone prescribes the planting up of upwards of 100 acres per annum. As already stated, the natural regeneration of the deodar is fully understood and given effect to, but there are many of the old ruined forests where no suitably situated parent trees exist over large areas, or where *Indigofera* has taken possession of the grounds, and here artificial cultivation is required. It is also of great importance in regard to the filling up of blanks, for, with a valuable tree like deodar, and taking the large demand for its timber into consideration and the restricted areas at our disposal, we have not much time to wait in bringing the area under a new crop as soon as the old one has been exploited.

The Charduar India-rubber plantation is an undertaking of considerable importance. Mr. Gustav Mann, who early foresaw that the natural rubber resources of Assam would dry up sooner or later, has the honour of having started this plantation in 1873, and by the end of 1883-84, 892 acres had been stocked with *ficus elastica*. Mr. Mann, fully convinced of the financial advantage to be gained, strongly recommended an indefinite annual extension at the rate of 200 acres per annum. The Government of India supported this proposal, but

the local Government not taking the same view, the work languished, and in 1889 the plantation had extended to only 1,043 acres. During that year I visited Assam, and a new impetus was given, and during the next four years 860 acres were added to the planted area. In 1894, however, the work was stopped once more for financial reasons. This had been threatening for some time, and the establishment of new nurseries had been neglected, and, instead of providing a proper continuity of healthy young nursery plants, the under-sized and suppressed specimens from the old nurseries were used, which accounted for comparative want of success in the final plantings of 1893. Mr. Hill, when acting as Inspector-General, visited Assam in 1896, and recommended that the work should once more be vigorously taken in hand. When I visited the plantation however, in 1897, I strongly deprecated an immediate extension with the bad planting material available. However, the establishment of new nurseries had already been begun, and a continuous supply of fresh plants will now be maintained. It has been temporarily settled to extend the plantation by another 1,000 acres during the next five years, but the annual establishment of new nurseries must not be neglected, or owing to the absence of good planting material further extension will be much delayed. Moreover of late years the planters of Assam have begun to grow

ficus elastica in their wasteland, and are glad of any surplus of healthy plants, which they should have for the asking. In 1898-99 some experimental tapping was undertaken, and the net profit realized amounted to R93 per maund, against R60, which formed the basis of the calculation in consequence of which the extension was stopped in 1894.

The extensive *Casuarina* plantations in Madras, and those of *Eucalypti* deserve special mention; otherwise the plantations of both the Madras and Bombay Presidencies are composed of numerous small blocks. Arboriculture in India is by no means confined to the efforts made by the Forest Department. Extensive, and almost invariably very successful arboricultural operations have been undertaken by the Canal Departments in several provinces along their canals and main water-courses. Large sums are also spent annually on district arboriculture, but the want of protection, which can be afforded to trees along district roads, is as yet an almost insurmountable impediment to the general creation of uninterrupted avenues along district roads. However, a great improvement has taken place of late years in this respect also.

Works of improvement of existing forest growth.

In the mixed forests in India, young trees of the more valuable species are always to be found overtopped and suppressed by others as yet of no value; and it often happens that young growth of the better kinds cannot make

headway under the leaf-canopy of worthless forest growth, or is smothered in the struggle with the more numerous representatives of plebeian kinds.

Under such circumstances, help must be afforded by girdling or felling the inferior trees, in order to make room for the teak, the padouk, the deodar, the sâl, or other valuable species. Much has been achieved in this respect especially with regard to teak in Burma, deodar in the West Himalayas, and sâl in the North-Western Provinces. Such operations have, however, the serious drawback of filling the forest with dry wood, which increases the risk of fire and adds to its violence, and can consequently only be undertaken in fire-protected forests, or in forests which do not burn on account of their position or otherwise. The cost of these operations, and the necessity for their close supervision, also limit their extension. To what extent these operations may properly be carried in each forest must be based on local observations. As regards trees which appear naturally in unmixed forest, such as the deodar or sâl, no apprehension need be felt, even if the trees with which they are associated are entirely removed. To judge from its general configuration, the padouk tree will probably also do well in pure forest. The teak, however, is, in the opinion of many a good Forest Officers, not intended by nature to form pure forest of large extent. The tree is leafless

during the hottest and driest part of the year and its fallen leaves form an inadequate protection to the soil, which gets both baked during the hot season and washed away during the early rains. Reproduction is found but rarely within the direct drip of the teak tree. The seed germinates, no doubt, but, owing to the heavy drip, the sprouting germ is covered by a layer of mud and sand a fact, which it is verified by the numerous small pyramids found under an old teak tree at the end of the rains, each containing a dead young plant. It has, moreover, been observed in Burma, as well as in the Central Provinces, that more or less pure teak forests have suffered greatly from attacks by insects, amongst which a species of *Tortrix* is the most destructive.

Creepers are in India a great danger to the development of forest growth; they smother and kill young plants, and prevent the development of straight sound timber even in older trees, and the forester must wage an unceasing war against them. Millions have been killed since the Forest Department took charge of the Government forest property, and the efficiency of a protective officer may often be correctly gauged by the absence of creepers in his beat. Another danger, less in degree, but even more difficult to deal with, consist in the growth of epiphytic *Fici*. Their seed, probably carried about by birds or squirrels, is deposited in the bifurcation in the very crowns of forest trees.

germinates freely, especially on leaf-shedding trees like the teak, and the rapidly growing plant soon encloses the tree in its deadly embrace. The only measure as yet found practical to counteract this evil is to fell the tree as soon as it is found to be attacked.

During the earlier periods of our forest administration the necessity of these measures was fully understood, but chiefly owing to the want of a sufficient staff of trained rangers, which even now is much too small to cope with all the work which might with advantage be done, they were carried out sporadically. However, working-plans provide for these operations and they are carried out systematically over defined areas year by year. It is said that many forests have to wait long years before the help of the scientifically wielded axe reaches them, but at present we cannot do more for want of money and men.

It is this same want which prevents us from giving that attention to thinning operations which the importance of the subject demands. We know very well that in many instances considerable harm is caused by leaving a forest too long unthinned. The development of the forest is greatly retarded thereby, and even the final yield may be largely reduced. But thinning operations are difficult to carry out properly, and if badly done may cause much harm rather than benefit to the crop. The more clearing out of inferior species which are

interfering with trees of more valuable kinds requires care, but thinning operations require the close supervision of trained foresters, and these we have not got in sufficient number. The produce moreover derived from such operations is, as a rule, unsaleable as yet, and the attendant cost considerable. It is owing to this that thinning operations are, as yet, mainly limited to artificial plantations.

The extent of natural forests in which thinning operations are pressing is limited and mostly confined to those composed of gregarious species, chiefly the sāl and conifers.

For some years it was believed that the teak *taungyas* would to a great extent clear themselves, but this hope has not been realised, and artificial interference with the crop has been found imperative.

Working-plans have as yet laid, in most instances, too little stress on thinning operations, but it is gradually recognized that more attention will have to be paid to the subject.

*Exploitation and
outturn.*

We have upwards of 1,200 species of trees in our Indian forests, but most of these were at the outset unknown to any but the professional, systematic botanists, and the value and technical qualities of all but very few of them were unrecognized, except for local use. Industries, as well as trade as it then existed, ignored all but a few species with particularly valuable qualities, and which at the same time were found in large quantities.

The most important amongst these were, and indeed still, are the teak (*Tectona grandis*), the deodar (*Cedrus deodara*), the sâl (*Shorea robusta*), the sissoo (*Dalbergia Sissoo*); the blackwood (*Dalbergia latifolia*), the khairs or cutch (*Acacia Catechu*), the sandal (*Santalum album*), the babûl or kikar (*Acacia arabica*), the toon (*Cedrela Toona*), the red sander (*Pterocarpus santalinus*).

A trade of considerable importance existed in these timbers when the Forest Department was established, but it was, with the exception of that in teak, more or less local; since then it had largely expanded.

The creation of markets for other kinds of woods, which are still unsaleable under existing conditions, has constantly occupied the attention of the Forest Department; for it is self-evident that the removal of an increased number of species represented in the *peuplement* of our forests must not merely benefit silviculture in the highest degree, but at the same time greatly facilitate the exploitation of the forests. It would appear easy to introduce many of the valuable and handsome woods to be found in our Indian forests into the general market, but this is by no means the case, and in spite of the continuous efforts which have been, and are being, made to introduce timbers of other kinds, success in this respect is but slow. Locally, no doubt, we have succeeded in bringing many previously unused woods into use, but a really

widespread demand we have as yet established for but few new species. The most important of these are the ironwood (*Xylia dolabriformis*) and the Andaman padouk (*Pterocarpus* sp.). As regards the former, I remember well the opposition by which we were met, when proposing that this wood should be used for the sleepers of the Burma railways. Success was not achieved till the Forest Department established the first small steam saw-mill in the vicinity of the forests and near the railway line, which enabled them to supply the sleepers at the lowest possible rate. From that time the demand for this wood grew, and it has now become one of the more important items in our Forest revenue. The Forest Department transferred their mills and contracts to private parties as soon as the position of the timber was insured in public favour, realizing as their share the value of the wood in the rough.

At present there are numerous private saw-mills in the Burma forests. They are chiefly occupied with the conversion of pynkado, but are of the greatest assistance to the Forest Department in bringing other woods to notice in the local markets.

The trade in the Andaman padouk has had a curious history. The wood was brought to notice through the Tenasserim padouk, and when the trade in it had been fairly established it was nearly wrecked through the influence of the same wood. As far back as 1875 the

Madras Gun Carriage Factory was annually supplied from Tenasserim with padouk for gun-wheels and gun-carriages at a very high and remunerative price. This attracted attention to the extensive padouk forests in the Andamans, and taking advantage of various exhibitions we advertized the wood largely, and, beginning on a small scale, soon established a remunerative export trade. When this had grown to considerable dimensions and the demand showed no falling off, some private firms in Burma began to export Burma padouk on a large scale, and lost heavily over their venture. Unfortunately some of our consignments from the Andamans, sent on a rising market, were not so well selected as those by which we had established the trade, and padouk wood generally lost credit with consumers and fell in price from 4*s.* 6*d.* and 4*s.* 9*d.* to 2*s.* 6*d.* and 3*s.* per foot. Then the Government of India did the right thing. They weeded out their stock, sold all inferior coloured and doubtful timber for what it would fetch, and restricted the exportation to the best and highest coloured squares. The consequence was that the timber not merely regained its position in the market, but that enquiries at 6*s.* 6*d.* a foot cannot be met in full. The timber of the Burmese padouk has all of the excellent qualities of the Andaman padouk, but lacks the brilliant colouring, which gives to the latter its exceptional value. In the Andamans

we have the highly coloured as well as brown padouk. In structure the wood seems identical, but still it is remarkable that wood, so materially differing in colour, specific weight and market value should be the produce of the same species grown under similar conditions.

India possesses many exceptionally handsome woods well adapted for furniture or veneer, which need only be brought into fashion, and timbers specially suitable for carriage-building or other industries; but the efforts which the Forest Department are in a position to make to bring them to public notice are few. Mr. Gamble's excellent "Manual of Indian Timber" gives a considerable amount of information as regards the technical qualities of our timbers, and ever since the Paris Exhibition of 1878 we have supplied numerous collections of hand pieces to various museums, exhibitions, institutions and private parties; but it is difficult to awaken a public interest by these means only, and unless and until woods are shown in the shape of manufactured articles, it is not likely that they will get into fashion. To do this on a large scale the Forest Department has neither the time nor the funds, and must depend to a great extent on private enterprise. To encourage such enterprise as far as possible has always been the aim of the Department, and this policy must continue, though the success achieved thus far has, as regards exports at least, not, as a rule, been very encouraging.

The question of impregnation of the less durable of the Himalayan conifers and other woods otherwise suitable for sleepers has on several occasions been under consideration, but as yet no practical results have been achieved, chiefly no doubt because the naturally more durable species have as yet sufficed to meet the demand, at a price which makes it doubtful whether impregnated material could be supplied at a proportionately lower cost. However, as the demand increases our extensive pine forests may be called upon to yield their share, and it is one of the important duties of the Department to facilitate and encourage any enterprise in this direction.

All our more valuable woods at present in use are now exploited under the provisions of working-plans or plans-of-operations, and the continuity of the supply is thus insured and often the steady increase. But this was not always the case; for, as already stated in the Introductory Chapter, notwithstanding warning examples, plentiful in the forest history of other countries, the most valuable Government forests were in the early days thrown open to private enterprise, and the forests were leased to capitalists. The experiment, as might have been foreseen, failed in every instance, in the Himalayan deodar forests, as well as in the valuable teak forests in Burma. Not only did the State not receive an adequate value for the forest produce actually extracted, but the future

of the forests was frequently ruined or endangered by a non-conservative working and reckless waste. The lease-holders, most naturally only thought how to make the greatest profit out of the forests, and fellings were frequently carried on in the most wasteful manner; measures necessary to ensure the reproduction of the forests and to prevent their deterioration in character, were almost universally neglected. An infinity of harm, which it will take decades to repair, has consequently been done mainly in the deodar forests in the Punjab, in the teak forests in Burma and the Central Provinces, and in the accessible sâl forests in the North-Western Provinces.

The establishment of the Forest Department made an end to this wasteful exploitation of the Indian State forests as soon as opportunities occurred. In Lower Burma the lease system, which, as already noticed, was entered upon in the face of the strongest opposition on the part of Mr. Brandis, existed longer than anywhere else, but came to an abrupt conclusion in all but a few unimportant areas in Tenasserim. The lessees, or at least their sub-contractors, were convicted of serious malpractices, and the leases were cancelled in 1873.

In 1886, however, extensive forest areas passed into the possession of the British Government with the conquest of the Burma kingdom, which under the previous Government had been leased out under the vaguest arrangements.

This constituted an inheritance surrounded by great difficulties. Conditions limiting the exploitation there were practically none under the old contracts, and the lessees were only liable to the payment of a lump sum per annum, without reference to the amount exploited. Had the leases been carried on unchecked under a civilized Government, the devastation of the forest was a foregone conclusion. It was then that the Forest Department claimed the right of interference, and after protracted discussion an amicable settlement was arrived at, under which the lessees paid a royalty on the amount of timber extracted, instead of a lump sum for an indefinite quantity, and by which the girdling operations were placed under the control of the Department. No doubt even under this arrangement the annual possibility of some forest areas was seriously forestalled, and a much smaller portion of the gross revenue found its way into the exchequer than would have been the case without these obligations, which the British Government inherited from the late Government of Burma. However, the valuable property though not quite unimpaired was saved from ruin. The last of the leases expires shortly and the timber left realizes double the price we obtained under the old régime. Renewed efforts were made within the last few years, as the end of the existing leases was approaching, to renew them on the old lines; but they were unsuccessful. The

Forest Department had its hands strengthened by recent malpractices, and though under the new contracts the Government engages contractors to exploit the outturn, and sells it to them at rates previously agreed upon, the Forest Department has the entire control of the exploitation, and the present arrangement practically resolves itself to the selling of standing girdled timber of a definite quantity.

Elsewhere most large timber of the more valuable classes is worked out by contractors under the direct management of the Forest Department and is sold after arrival in depôts. The Department also undertakes in many instances the preparation of forest-sawn sleepers and their export to the markets. Considerable improvements have taken place everywhere in the exploitation of timber, not only as regards the more careful selection for silvicultural reasons of the trees to be felled, but also in the process of extraction. I remember the time when the timber in the Himalayas was tumbled down the hillsides anyhow, and what escaped this rough usage was thrown into the hill streams and left to find its way to the plains unaided. The destruction and loss under this system was of course excessive. It was not long, however, after the institution of the Forest Department that slides, sledgeways and sleepershoots were employed. The time when a forest in the Central Provinces was described as impassable on account of thousands of dead

teak trees felled and abandoned in the forest has passed away and is a matter of forest history only. In Burma the timber is dragged, as formerly, by elephants, into the hill streams and pushed down during the freshets till it reaches the floatable streams when it is caught and formed into rafts, but here also constant improvements have taken place in the export roads. The timber and fuel to supply local demands, and in many cases the fuel-supply for large towns, is extracted by purchasers. Numerous have been the systems to regulate and check this system which varied from Province to Province and frequently even by Districts.

But all of these were for a long time purely revenue schemes, and in many places still exist as such only. However, as working-plans extend, silvicultural control is being added, the purely fiscal schemes are more and more abandoned, and the exploitation is restricted to certain fixed areas—the coupe of the year. Wherever feasible such coupe is sold standing, but this is not always possible, and on other occasions would inflict a hardship on the villagers in the vicinity, who are in a position to use their own labour and teams for the extraction of the forest produce they require.

To meet these requirements, two systems are in use. Under the first of these, ingress into the forests is free, and payments are only made on the material removed, when it passes the

forest boundary. Under the other system, the purchaser is first required to obtain a permit for every particular species of tree of particular dimensions. Both systems have their advantages and disadvantages, but it is self-evident that the prescriptions of silviculture are insufficiently safeguarded under either. They are a transition stage towards more advanced systems of management, and can only gradually be circumscribed by the provisions of working-plans. Much has already been done in this direction, and it would, in my opinion, be unwise to hurry the development towards a system of purely departmental working. The country is not ripe for this as yet, and the progress we have made towards a more systematic and conservative exploitation is satisfactory. A more rapid advance would only cause dissatisfaction and probably reaction.

As a rule, moreover, when the exploitation has not been restricted to a circumscribed area—the coupe of the year—when the trees to be retained are specially marked, certain favoured species, such as teak in the Central Provinces, are either entirely protected, or protected by higher rates, as the sundri (*Heritiera littoralis*) in the Sundarbans, and permits are usually only granted for trees of such species as it is desirable to remove from the forests for silvicultural reasons.

The yield of the Government forests in the Provinces under the Government of India in

timber and fuel was estimated in 1880-81 as follows :—

	Tons.
By Government agency	32,327
„ Purchasers and permit-holders .	108,898

In 1884-85 it stood as follows :—

	Tons.
By Government agency	148,000
„ Purchasers and permit-holders .	860,000

and in 1897-98 it was—

	Tons.
By Government agency	*241,000
„ Purchasers and permit-holders .	*1,750,000

The Indian forests yield large quantities of *Minor forest produce* minor forest produce, a considerable amount of which is derived from the Government forests. As regards local consumption, the most important articles of minor forest produce are bamboos and grass. The former are almost universally extracted under the *Kham Tahsil* system, under which entry into the forests is free and payment only made on the material removed, and this, if the demand is not in excess of the capabilities of the bamboo forests, is eminently suitable. In the North-Western Provinces, however, it was found that the bamboo forests, which are of moderate extent, were being ruined partly on account of the excessive

* For purposes of comparison with the figures for 1880-81 and 1884-85 these figures exclude the yield from forests in the Madras and Bombay presidencies.

demand, and partly on account of the large increase of the herds of elephants. Rules have been introduced prescribing a more conservative cutting of bamboos, and the elephant herds have been reduced by successful kheddah operations. A simple revenue system was also found insufficient for the protection and maintenance of the comparatively small bamboo areas in the Punjab.

The yield from the bamboo-producing areas under the control of the Forest Department has been estimated at 82,000 in 1800-81, 120,300,000 in 1884-85, and 140,842,000 in 1897-98. This is in every instance probably far below the total number of bamboos extracted, but nevertheless the income derived from the sale of bamboos amounted only to ₹3,31,000 in 1880-81, ₹4,85,000 in 1884-85 and ₹5,68,000 in 1897-98.

The revenue from grass is a most important item. In most instances the grass crop is as yet reaped by the most wasteful of all methods—*viz.*, by grazing. It is well known that in this manner less than 30 per cent. of the grass crop is realised, the rest is trodden down, or consumed by fires; the reproductive power of the forests is greatly reduced, and year by year the coarser grasses increase in proportion, and the value of the pasture is depreciated. This has, however, been the custom of the country from time immemorial and cannot be changed suddenly, however desirable. The increase in

the number of cattle has always been regarded as one of the standards of agricultural prosperity, and such increase has no doubt been fostered by the existence of large grazing areas. The cattle, however, bred under such conditions are, as a rule, of no great value, and in the drier zones are annually exposed to want, and in unfavourable seasons to starvation. The number of cattle is therefore constantly fluctuating; a few favourable seasons, and they increase to the maximum that can find grazing; a few seasons of drought, and they die off again. Indeed, the facilities offered to grazing in Government forests are so great as to offer a positive premium to over-breeding, and therefore to the deterioration of the breed; quality is thus sacrificed to quantity. This is of course unsatisfactory, but the conditions of the country render any sudden change in the present system impossible; and it is but natural that the raiyat should prefer to send his cattle to graze, to cutting and carrying the grass for them. It is infinitely more comfortable, and it is not to be expected from the common peasant that he should see the danger ahead, and be able to judge correctly of the advantages derivable from a change of this old custom.

Several Local Governments have of late years given great attention to this subject, and to the establishment of grass and fodder reserves, by which a certain portion of the forest and grass lands is withdrawn from the general

annual grazing, and partly opened during the months in which the grass is scarce and partly only in years of distress.

This was an important step towards a more conservative treatment of the grass crop, though it seems doubtful whether it has been carried out with the thoroughness originally contemplated. A more rational treatment of the grass crop, however, is spreading, and develops fairly rapidly whenever the grass becomes of commercial value. I remember the time when fires on the hillsides between Simla and Kalka were as common as they are still on the hills north of Dehra, but there are none now; the grass is all cut and stacked. This is of course quite a special case; but in the Berars, parts of the Bombay Presidency, and even in some of the old head-quarters of the nomad grazier, agriculture gains, and we see fodder and grass stacked and even sold. In the Amritsar District in the Punjab, the Forest Department tried to create forest reserves in 1870, or about that time, of some of the extensive wastes still in existence, but it was stated that the areas were indispensable as grazing grounds. Now they are mostly cultivated and their want is not felt.

The systems of regulating the grazing vary greatly in the different provinces, and even in districts of the same province. In some cases the grazing over the areas not closed for forest reproduction is let to contractors, who make

their own arrangements to collect fees from the cattle owners; in other cases the cattle grazing are enumerated within the forest or grazing areas, and a fee is levied per head; in others again, the villagers pay on an enumeration of the cattle in their possession, which are then allowed to graze in certain forest areas, or sometimes even over all forest areas of a district. In these instances plough cattle are sometimes admitted at lower rates; sometimes cows are admitted free, calves at heel always, and frequently older calves. Pack cattle belonging to tribes of carriers are, in the Central Provinces, admitted to all open grazing grounds of the province under a general pass.

In many instances cattle are grazed free within Government forests by rights acquired under forest settlements. This of course is unavoidable, but such free grazing, or grazing at lower fees, has often been extended by Local Governments as a privilege to other villages for no other reason than that they are situated within a certain distance of the Government forests. These privileges are theoretically revocable, but have in practice the same force as legal rights. Cattle belonging to forest villages which supply the labour for fire-tracing and other forest work, and frequently occupy part of the State forest as tenants, are, as a rule, admitted under free passes.

It is in the interests of the State to utilize its forest property to the full extent of its

capabilities, and to sell all its produce, including grass, to the best advantage of the exchequer as well as of the raiyat, and to allow grazing where it can be done without endangering the well-being of the forests, and when it would be most profitable for the raiyat; but natural forest areas cannot be treated in the same manner as *bona fide* grazing grounds, such as the Alpine pastures of the higher Himalayas and the *bar* *rakhs* of the Punjab.

Numerous rules have been promulgated to regulate and organize the grazing; but however carefully they may have been prepared, it is impossible that they should meet every case. As a matter of fact they tend to give a general fixity to a system which under certain conditions is wasteful, and under such conditions should be allowed to die out gradually.

The conditions, which vary in each forest area, can only be satisfactorily met by suitable prescriptions in working-plans and not by general rules.

The income derived from the sale of grass and grazing has been as follows :—

	R
In 1880-81	9,57,720
„ 1884-85	12,48,441
„ 1897-98	13,51,850

but these figures represent only a portion of the value of the produce actually extracted, as the real market value is rarely realized, and much material is extracted under rights and conces-

sions. The estimated value of this amounted to R13,45,124 in 1897-98.

The chief minor products in demand by the trade are caoutchouc, cardamoms, cutch, lac, myrabolams, and resin. The exploitation of these products is almost entirely in the hands of purchasers and permit-holders.

India's trade in caoutchouc—the product of the *Ficus elastica*—is decidedly on the wane. From 1870-71 to 1875-76 the export averaged 785 tons per annum; from 1892-93 to 1896-97, 422 tons; and in 1897-98 it fell to 278 tons only. At the same time the price rose from R1,356 to R3,038 per ton. If, therefore, a larger quantity of rubber was procurable, it would be forthcoming. A very small proportion of all the rubber exported from India is produced within the country under effective control, and we may safely assume that the trees which yielded the larger supply are dead. There are other species in India producing fairly good caoutchouc, but they also appear scattered about, and their rubber is difficult to collect and bring in a sound state to market. The Burma Government are about to undertake experiments both as regards the collection of cutch from forest grown trees, and the establishment of plantations of caoutchouc-yielding trees of various kinds.

The trade in cutch has of late years been seriously affected by the introduction of more scientifically prepared substances of a similar

character. However, nothing is required but the introduction of similar method, in order not merely to regain the former position, but to improve on it, as India is very rich in tannin-producing species.

The trade in myrabolams has largely increased, and during late years has maintained itself at upwards of 44,000 tons against less than 18,000 tons in 1876-77. The price, however, has not advanced in the same measure as that of tannin extract, having only risen from R75 to R80. The price of extracts during the same period has increased by 100 per cent., but the demands, as regards the quality, are much higher than they were in 1876.

The trade in cardamoms is really unimportant but interesting, as being one of those small enterprizes or gambles which but a few initiated ones understand. The produce varies in price at the shortest notice as much as 25 per cent. and apparently without reference to the amount locally produced.

The resin of *Pinus longifolia* has only of late years been introduced into the market, as colophony and turpentine, by Government, who built a distillery on a small scale at Dehra Dun. Both the colophony and turpentine produced are equal to the best French product, and the Indian trade and manufactures, being quite certain of getting a perfectly pure article of the first quality, are absorbing all that is manufactured. Two more factories are being set up

with a view of transferring the manufactory when fully established, to private enterprize. A distillery on a somewhat larger scale is also being set up in the Kangra Forest of the Punjab.

There are many other products such as sabai grass for paper-making, fibrous plants, etc., in which small local trade exists, or is gradually springing up, and I have no doubt that the Forest Officer of the future will still find many sources of wealth, which we have overlooked, undervalued, or not understood.

The financial progress of the department can best be judged from the following statement of annual averages, though I beg it to be understood that the Inspector-General of Forests does but indirectly influence the growth and control of revenue, which is much more dependent on Conservators and their Divisional Officers :—

*Financial results of
Forest Administration.*

Period.	Revenue.	Expenditure.	Surplus.	Percentage of Expenditure to Revenue.
	R	R	R	Per cent.
1864-65 to 1880-81	53,54,900	35,25,000	18,29,900	65·8
1881-82 to 1884-85	99,54,100	63,51,400	36,02,700	63·8
1885-86 to 1897-98	1,51,87,400	86,21,000	65,66,400	56·7

The average quinquennial growth since 1864-65 has been as follows :—

Quinquennial periods.	Gross Revenue.	Expenditure.	Surplus.	Proportion of Expenditure to gross Revenue.
	R	R	R	Per cent.
1864-65 to 1866-67 (3 years' average).	36,29,312	22,29,881	13,99,481	61
1867-68 to 1871-72	46,34,453	32,95,160	13,39,293	71
1872-73 to 1876-77	65,38,373	44,09,179	21,29,194	67
1877-78 to 1881-82	73,80,431	49,42,512	24,37,919	67
1882-83 to 1886-87	1,06,78,807	68,31,284	38,47,523	64
1887-88 to 1891-92	1,42,46,891	80,69,590	61,77,301	56
1892-93 to 1896-97	1,71,60,426	93,99,796	77,60,630	55

The revenue of the year 1897-98 amounted to R1,77,95,490.

It may be interesting to compare for different periods the revenue and expenditure under the various heads, with the proportion of the gross receipts expended, and I add it for 1880-81, 1884-85, and 1897-98 :—

Various Heads.		1880-81.	1884-85.	1897-98.
		Amount.	Amount.	Amount.
		R	R	R
Gross Receipts	(a) Wood . . .	51,88,671	76,36,624	1,37,39,530
	(b) Minor forest produce.	6,75,503	10,02,062	12,04,160
	(c) Forest stamps and commutation fees for forest produce.	92	...	5,71,200
	(d) Grass and grazing.	9,57,720	12,48,441	13,51,350
	(e) Revenue from forests not managed by Government.	4,00,224	95,869	3,52,410
	(f) Miscellaneous	1,65,078	2,07,174	5,76,840
TOTAL REVENUE .		73,87,488	1,01,90,170	1,77,95,490

		1880-81.		1884-85.		1897-98.	
Various Heads.		Amount.	Proportion of Expenditure to gross Revenue.	Amount.	Proportion of Expenditure to gross Revenue.	Amount.	Proportion of Expenditure to gross Revenue.
		R	Per cent.	R	Per cent.	R	Per cent.
A. Recurring.	(a) Administration.	11,53,970	15.62	15,23,323	16.00	22,06,940	12.40
	(i) Superior Staff.	...	...	...	...	1,27,140	0.71
	(ii) Exchange compensation allowance.	...	...	...	...	...	...
	(iii) Subordinate Staff (including Rangzars, Foresters and Guards).	5,34,741	7.34	7,03,453	6.95	16,20,880	9.18
	(iv) Office Establishments (including Contingencies).	3,11,803	4.32	4,69,950	4.61	8,66,940	4.87
	(1) Extraction.	19,36,167	26.24	27,31,498	26.81	29,09,930	16.34
	(2) Roads and Buildings.	1,68,431	2.23	2,77,570	2.73	4,88,030	2.73
	(3) Fire-protection.	8,888	1.09	1,29,378	1.27	3,13,600	1.76
	(4) Cultural operations.	3,12,571	4.23	5,61,674	5.51	3,00,200	2.03
	(5) Live-stock, stores, tools and plant.	1,01,637	1.38	1,53,072	1.47	2,47,490	1.39
B. Extraordinary.	(6) Working-plans.	...	...	...	...	75,920	0.41
	(7) Rent for leased forests.	1,00,156	1.36	1,03,114	1.01	1,40,150	0.79
	(8) Miscellaneous.	37,360	0.51	58,647	0.58	1,13,210	0.64
	(c) Expenditure on realization of revenue from forests not managed by Government.	7,193	0.09	14,505	0.14	10,400	0.06
	(d) Forest Science and Education (including all "A" and "B" charges of Forest School).	...	...	41,089	0.40	71,980	0.40
	TOTAL	47,46,077	64.27	67,74,156	66.43	95,52,750	63.68
	(e) Forest Settlement.	19,681	0.26	1,19,545	1.17	65,520	0.37
	(f) Forest Surveys.	34,870	0.47	52,091	0.79	4,61,080	2.53
	(g) Forest Demarcation.	67,197	0.91	80,743	0.51	1,26,430	0.71
	TOTAL	1,21,748	1.64	2,52,384	2.47	6,42,930	3.61
	GRAND TOTAL EXPENDITURE.	49,69,825	65.91	70,26,510	68.95	1,01,95,780	57.29
Net Revenue		25,17,663	34.09	31,63,660	31.05	75,99,760	42.71

The cash revenue is not the only benefit the forests, under the administration of the Department, confer on the country. The value of forest produce annually consumed by right-holders, given away by Local Governments, as privileges and free-grants is very large indeed. It has only lately been attempted to estimate the value of such concessions, which during 1897-88 amounted to 35 lakhs of rupees. This figure does not include the value of produce from forest areas and waste lands outside the control of the Forest Department, where *mostly* no restriction whatsoever exists.

The foregoing pages will, it is hoped, convince the reader of the incalculable importance of the forests in our Indian Empire and of the necessity for their protection; show that the Government hold in their State forest property a trust of considerable magnitude; and prove that, considering the innumerable difficulties which surrounded the beginning of a new undertaking, such as forestry was in India, good and sound progress has been made in the administration of this trust.

It must be acknowledged that forestry in India is even now still in the stage of development and that much remains to be done with regard to the consolidation, protection, treatment, and utilization of the State forests; the introduction of the use of timber of the inferior kinds, and the development of industries consuming wood and other forest-produce, but it

cannot be denied that the work of the last 45 years has been steady and unswerving.

As already stated, when the new Department was first formed it was of necessity officered by gentlemen of no previous special training. *Technical Education.*

Though, however, a considerable number of excellent administrative Forest officers were thus obtained, it was soon considered advisable to introduce a more scientific management, and to take advantage of the knowledge which had been gained in this respect in Continental countries by several centuries of experience. Before the result of this resolution could take effect, and before officers sufficiently trained could arrive in India, some time had naturally to elapse; and Mr. Brandis, the then Inspector-General of Forests, was permitted, towards the close of 1866, to select two young officers trained for the Forest Service in Germany, one of these was Dr. William Schlich, my predecessor as Inspector-General of Forests and now head of the Coopers Hill Forest School, the other myself. At the same time arrangements were made for the training of young Englishmen in the Forest Schools of France and Germany. At the end of 1875 the professional education was entirely transferred to Nancy. The first officers thus specially trained arrived in India in December 1869, and since then 95 officers have joined under this arrangement.

The officers obtained under this system have, with few exceptions, which must always occur, greatly helped in the introduction of a sound forestry system into the Empire, and our present class of Conservators, permanent and officiating, is greatly composed of them. They are good foresters and good administrators. Amongst so many in the first flight, it is a difficult task to judge the leaders, but I consider that Messrs. Hill, Gamble, Wroughton and Dansey amongst those who came to us from France, and Messrs. Popert, Wilmot, Oliver, Nisbet, and Carter, who learned forestry in Germany, deserve this distinction. The officers who joined during the last years of recruitment through Nancy, though death and retirement have greatly reduced their number, still present a rich field of selection for the class of Conservators. With such selection impending at no distant date, etiquette prohibits me from mentioning those I consider to have the highest qualification as Foresters. Of the 95 officers recruited between 1869 and 1886, 45, or more than half, have already died or left the Service.

In 1881 a change in the recruitment for India was for the first time seriously discussed. Difficulties had arisen as regards the Continental training in Germany, which led to the abandonment of the recruiting through German forest schools in 1875, and it seemed likely that the same might happen in France.

The Government of India were very un-

willing to give up the training grounds through which such excellent results had been achieved, and it was not till 1884 that the establishment of a national Forest School in England, in connection with the Coopers Hill College for Engineering, was decided upon. It was successful from the outset, and even the first year's outturn gave us as good a set of officers as we could wish. This success from the beginning is entirely due to Dr. Schlich. When the whole school is established and in complete working order, we may have men to replace him, but at the time there was, it is not too much to say, nobody in or out of the Service who could have commanded the same success.

At first the course of study extended over about 26 months. During 22 of these, the candidates prosecuted their studies at the College. The remaining 4 months were spent under suitable supervision in selected British and Continental forests.

In 1888 Dr. Schlich made three proposals in order to afford a more complete training to the officers sent out for appointments in the Imperial Forest Service of India :—

- (1) To extend the course over 3 years.
- (2) To appoint a second Professor of Forestry.
- (3) To relieve the present Professor of taking the students on the Continent, so that his services might be available at the College for lecturing

during all the six terms of the two years, instead of four terms, as had been the case till then.

Every one of these proposals has been accepted. The course extends now over three years, a second Professor of Forestry has been provided by the appointment of Mr. Fisher, for some time Director of the Forest School at Dehra Dun, and the study of forestry on the Continent has been re-arranged. The students are now for several months attached to a selected Forest Division in Germany and the tour at the end of their course is much curtailed.

There can be no doubt that this is a great improvement. The students now learn detailed practical work, in a circumscribed area it is true, but their eyes and minds get trained, and they will be better able to understand, to profit by and to retain the impressions of their subsequent Continental tour, which even under the best of guidance must unquestionably be more fleeting to a practically less trained understanding.

During the first years of the existence of Coopers Hill as a Forest college, the entrance examination included natural sciences amongst the obligatory subjects. Under strong influence, exercised in England, this was changed in 1890. Dr. Schlich, Mr. Hill when officiating as Inspector-General, and myself recorded strong protests which, however, were of no avail. In the prospectus of 1900, botany has

again been included, and a very high percentage of marks has been allotted to this subject. In one sense this is an important step in the right direction, but it is one-sided, and it would have been preferable if the branch of natural sciences had been left to the choice of the candidate, more especially as we are able to obtain much better assistance from professional botanists than in other branches—as, for instance, in entomology. The importance of this science to Indian forestry has never been entirely recognized at its full value, and it is only of late that more concentrated and widespread attention has been paid to the life-history of our injurious insects. I took the opportunity of Mr. Stebbing's knowledge and taste in this respect of starting the organization of Departmental researches. It is essential and of great advantage that the Forest Department in India should occasionally produce an eminent scientist. It gives a certain tone to the Department as regards the world at large, which cannot be obtained in any other way. Men like Sir Dietrich Brandis and Mr. Gamble are eminent foresters and administrators, as well as eminent scientists, but such combinations are very rare, and I know of no others in the history of the Department who could share this distinction to the same degree, and of no other botanist who has left a permanent mark on the organization and development of the Department to an even approaching extent. I agree

with Dr. Schlich that the ordinary man when introduced to practical forest work in India finds no time for special botanical study. The special study of botany is moreover not necessary to, nor can it ensure a knowledge in silviculture, and most of those already named as founders of the present Department and scores of our best silviculturists, amonagists and administrators generally—such as (I may be permitted to cite a few amongst many who, I am happy to say, exist) Hill, Wilmot, Popert, Oliver, Carter, Fernandez, Bagshawe, Wroughton, Beadon Bryant, etc., etc.—can raise no claim to be botanists in a wider sense than to be able to utilize the knowledge of professional botanists which must always be the foundation of much of our work. Nevertheless the study of botany and other sciences auxiliary to forestry is fully encouraged in the Indian Forest Department, sometimes even at an administrative sacrifice, and we have men, such as Messrs. Talbot, Lace, McDonell, and Stebbing, for instance, who neglect neither the one nor the other.

The Forestry Branch of Coopers Hill College, as at present organized under its distinguished head, Dr. Schlich, gives the Imperial Forest Service of India all it requires, and the Government may well join me in a "*vivat, floreat, crescat*" as regards that institution on its present lines. It gives us foresters who love their forests and who possess all qualifications to make them good administrators.

of the vast forest property consigned to the care of the Indian Government. Up to the end of 1897-98 it has provided us with 104 officers, of whom, I am sorry to say, five have already died and one resigned.

Mr. Brandis, as early as 1869, drew attention to the necessity of providing the means for a technical education in forest science in this country and of training natives of this country for forest work by means of a combined course of theoretical and practical instruction. A beginning was made by placing selected natives under officers who were considered specially qualified to instruct them; but though a few good men were thus turned out, amongst them one of my own pupils—Hadjee Fazl Din, now Extra-Assistant Conservator in charge of a division in the Punjab and awarded with the title of “Bahadur”—it had soon to be acknowledged that it was quite impossible to provide in this way for the growing demands of a constantly increasing staff. The next attempt was to apprentice a number of young men to forest divisions in their own provinces for a year or two, and thence to send them for a year to the Roorkee or some other Engineering College for theoretical instruction. This experiment also had not the results desired. The apprentices whilst attached to the various divisions received practically no instruction in forestry, but were used as welcome additions to the local staff on such mechanical and office work as they could

perform, and though when ultimately sent to Roorkee they became more or less proficient in drawing, road-making and building, they again learnt no silviculture nor received any instruction in natural sciences.

As early as 1873 it was proposed by Dr. Schlich, then Conservator of Bengal, to expand the Roorkee scheme by adding forestry classes; but the suggestion was not adopted.

In the meantime the Forest Survey Branch had been established in Dehra and young forest officers had from time to time been deputed to receive instruction in surveying. It was then that Mr. Brandis pointed out the special advantages of Dehra in the Dun as the future seat of the Indian Forest School, and laid the foundation of a forestry museum and a library. A year or two later, when the Roorkee training had had a good trial, some of the most influential Conservators addressed their Governments advising strongly that it should be abandoned. Mr. B. H. Baden-Powell of the Civil Service, who for many years was a tower of strength to our Department, both as Conservator and Officiating Inspector-General of Forests, wrote very strongly on the subject. He considered the Roorkee training as a failure, the apprentices being turned out as overseers and draftsmen and not as foresters; he urged on the Government of India the establishment of a Forest School; and suggested that in Captain Bailey and his Survey staff in Dehra, and with

the neighbouring forests as a training ground, he saw a practical nucleus for a Forest School.

It was thus that the Forest School in Dehra Dun was established in 1878. The forests between the Jumna and Ganges, comprising a great variety of forest vegetation, and including several zones, were set apart as training grounds, and formed into a separate Forest Circle under the control of the Director.

It was intended, an intention which has long since been given effect to with admirable results, that these forests should be subjected to a regular system of management, based on the experience gained in the forests of Europe. Captain F. Bailey, R.E., was appointed the first Director. This was an excellent choice, and it was entirely owing to Captain Bailey's exceptional powers of organization, energy and ability that the new institution took healthy root from the outset, which enabled it to develop as it has done. During the first few years of its existence, the Forest School was entirely subordinate to the Government of the North-Western Provinces, but a Board of Inspection was appointed, consisting of the Inspector-General of Forests, Dr. Schlich, the Conservator of Bengal, and Mr. Gamble, Personal Assistant to the Inspector-General of Forests. The staff of the School Circle was somewhat strengthened by the transfer of Mr. Smythies, now Conservator in Burma, and Mr. Fisher, now Professor of Forestry at

Coopers Hill College, but it was not till April 1881 that the beginning was laid of a special teaching staff. The first course of systematic theoretical instruction was opened on the 1st July of that year. By a Resolution of the Government of India, dated 3rd June 1884, the School was made an Imperial institution, and the Inspector-General of Forests was charged with its supervision.

The constitution of the Board of Control in 1890, which we entirely owe to Mr. Hill, who was at the time officiating for me, has had a further reaching influence on the development of the School in the right direction, than anything else in the annals of the institution. This Board, consisting of the Inspector-General of Forests, the Director and three Conservators, with the Assistant Inspector-General of Forests as Secretary, meets once a year at Dehra, conducts the examinations, scrutinizes the syllabus and discusses all matters connected with the management of the School, and records resolutions thereon. Mr. Hill proposed at the same time the appointment as Director of Mr. J. Sykes Gamble.

This was the best appointment that could have possibly been made, for in Mr. Gamble we had the scientist, the practical forester, and the administrator, excellent and indefatigable in all. It was natural that under such administration it should rise to its present high standard. The School is provided with decent class-

rooms, excellent and sanitary quarters, a sound water-supply and good drainage, a good library, splendid scientific collections, a good show of instruments and appliances, a decent laboratory, a resin distillery, and an apparatus for the extraction of tannin, the whole standing in a handsome and well-cared-for garden. The School forests, the training ground of our students, are well managed and flourishing under the care bestowed on them, and the whole forms an institution of which we are justifiably proud.

Though at one time the possibility was discussed of extending the Dehra Dun Forest School so as to afford a training ground for officers of the Imperial Service, it was originally established for the purpose of affording an adequate training in forestry to the officers required to fill the executive charges and those of minor control in the Indian Forest Service. This object the School fully fulfils.

There are two courses—one in which the teaching is given in English for Rangers, the other in which instruction is conveyed in the vernacular for Foresters. As this latter course would be useless for the training of subordinates for Burma, a special vernacular Forest School has recently been established in that Province, and it may be found advisable to create another establishment of this kind in Southern India.

As regards the teaching in even the Rangers'

class, it must be taken into consideration that the average standard of general education at the time when students join is not very high, and that the period allowed for the courses, even as now extended, is only $23\frac{1}{2}$ months.

A higher and more extended teaching is consequently out of question, nor is it, in my opinion, required, as for the object in question the present teaching meets our purpose. The teaching is throughout practical, and though a great part of the course is carried out in the forests, this produces many really practical silviculturists and sometimes original observers, such as Babu Upendra Nath Kanjilal, a botanist of considerable attainments.

Officers trained at the School are also eminently useful as regards the collection of material for the preparation of working-plans, but the claim that they compare favourably in the preparation of working-plans with the officers drawn from the Continent and Coopers Hill is, to say the least, premature. Some really good working-plans have appeared over the signature of some of them, but they have generally been edited, if that is a sufficiently strong expression, by our best amenagists drawn from the Continent.

When the Dehra School was first established, it was intended to have a special course for the education to direct appointments of the Sub, since called Extra-Assistant Conservator class. This course, however, has never been

established in practice, and is not required under the present policy of Government, according to which such appointments are to be made from the ranks of the Rangers. However, this principle has not always been adhered to in practice, and as the only real excuse for direct appointments can only be found in a higher standard of education, the subject has now been allowed to drop entirely.

The Dehra Dun Forest School provides Rangers for the Provinces included in the Bengal Presidency and for Madras. The Bombay Presidency have their own Forest School in connection with the Engineering College at Poona.

Up to the end of 1897-98 the Dehra Dun Forest School has issued 343 Rangers' certificates and 105 certificates in the vernacular class.

Before the Indian Forest Department was organized, no literature whatsoever existed in this country treating of silviculture, amenagement, forest laws and forest management generally. We had no Forest Floras nor any other comprehensive scientific books for the special use of Forest Officers. As a matter of fact there was an extreme poverty of books on forestry in the English language.

Indian Forest Literature.

Matters have considerably changed since then. The first books were naturally botanical surveys of the property brought under the control of the Forest Department. The value

of these works is enormous ; for though the every-day forester need know only a comparatively small number of the numerous species which are represented in our Indian forests, the number he must know is nevertheless considerable, and he must have a handbook from which he can ascertain the universally recognized name, etc., of any species of tree, shrub or climber which may become of special commercial use or of special injury to his forests. Without such botanical works he would find it impossible to communicate any observations he may have made as regards the sylvicultural or commercial importance of any plant intelligibly, and would be unable to profit by discoveries made by others. The most important of such works are—

Colonel Beddome's "Flora Sylvatica of Southern India and Ceylon."

Dr. Brandis' "Forest Flora of North-West and Central India."

Mr. Sulpiz Kurz's "Forest Flora of Lower Burma."

Mr. Gamble's "List of Trees, Shrubs and large Climbers found in the Darjeeling District, Bengal."

Mr. Talbot's "Sytematic List of the Trees, Shrubs and Woody Climbers of the Bombay Presidency."

Mr. Gamble's "*Bambuseæ* of British India."

Babu Upendra Nath Kanjilal's "Forest Flora of the School Circle, North-Western

Provinces" (specially intended for the use of students at the Dehra Dun Forest School).

One of the most practical and useful works has been Mr. Gamble's "Manual of Indian Timbers" of which a new edition is at present under preparation by the author.

Mr. B. H. Baden-Powell's "Forest Law" is another standard work which no Indian forest official should be without, even after he has passed his examination in Law.

Mr. Rogers' book on Forest Engineering also deserves a place amongst the more important works which have appeared under the ægis of the Department.

Dr. Schlich's comprehensive Manuals on Forestry are publications of the very highest professional merit. They comprise five volumes, *viz.* "Introduction to Forestry," "Practical Sylviculture" and "Forest Management," from the able pen of Dr. Schlich himself, and "Forest Protection" and "Forest Utilization," being translations from German standard books by Mr. Fisher.

Amongst other books of considerable merit published by Indian Forest Officers, it is necessary to mention—

Mr. Fernandez's "Manual of Indian Sylviculture."

Mr. Fernandez's "Notes on Forest Utilization."

Mr. D'Arcy's "Preparation of Forest Working-Plans in India."

Mr. Fisher's "Manual of Indian Forest Botany."

Mr. Clifford's "Notes on Forest Zoology."

Mr. Heinig's "Glossary of Botanical Terms."

Mr. Stebbing's "Injurious Insects of Indian Forests."

Dr. John Nisbet has also written a number of books and pamphlets of considerable value, dealing chiefly with European forestry.

A manual of mathematics, especially intended for Indian foresters, is under preparation by Mr. A. P. Grenfell. Besides these, we have a number of Manuals and Lecture Notes written and published for use of students at the Dehra Dun Forest School.

The "Indian Forester," a monthly magazine of forestry which was started by Dr. Schlich in 1875, and of which 24 volumes have appeared, also contains much of value and interest.

It must be acknowledged that the Indian Forest Department has contributed a large share to the development of an English forest literature, but as yet we have no comprehensive books either on insects injurious to forest growth, nor diseases of forest plants. These wants are most important. We have had already indications that insects may do widespread damage to our Indian forests and as, under our present management, the intermixture of our most valuable trees becomes more and more pronounced, and in many

instances will lead us to the establishment of large areas of more or less pure forests, this danger from insects may, and probably will, become more intense in the future. For this we should become fully prepared and armed. During the last year, for the first time, Mr. Stebbing, a Forest Officer in Bengal, compiled a manual of all that had so far been published as regards injurious insects. This I circulated amongst Forests Officers, with an appeal for assistance in collecting specimens and data for the life history of the various injurious insects. The result has so far been very gratifying, and with the necessary assistance it is hoped that the foundation will soon be laid of a practical and valuable work.

Forests belonging to the various Native States, to jagirdars, malguzars and other landed proprietors, form a considerable portion of the total forest area of the Indian Empire, and are in many provinces, where the forest property belonging to the British Government is insufficient to satisfy the direct and indirect demands of the country, of the greatest importance. No practical interference with the management of private forest property has as yet been attempted; and though the Forest Acts contain certain provisions regarding the formation of Village Forests and the control over forests and lands not being the property of Government, private forest lands are at present still unprotected by any special law.

*Forest Admin-
istration in
Native States.*

Most of the landed proprietors within British territory, and many of the Chiefs of the Feudatory States, especially in the neighbourhood of the Mahanadi, some of whom possess sâl forests of great value and extent, show as yet no desire towards real forest protection, and their chief aim is to transform their trees as soon as possible into money, without the least attention to the future of the forests or the revenue of their successors.

The larger and more enlightened Native Governments, however, have followed in the footsteps of the Government of India and established Forest Administrations of their own. The most prominent amongst these are Mysore and Kashmir, who have placed their administration under an Imperial Forest Officer lent by the Government of India, and each of whom obtain a permanently secure revenue from the State forests of some R11,00,000 per annum. Baroda, Hyderabad, Jodhpur, Patiala, Sirmoor and several others have also introduced a more or less conservative forest management, and the forests belonging to the small Native States in the Simla District have been placed under the supervision of an Imperial officer of the Government of India. The importance of the advance in this direction, which is still spreading and which is entirely due to the correct example set by the Government of India, can hardly be overvalued. In former times, no doubt, consider-

able sums were occasionally, and at intervals, obtained by Native Chiefs from speculators and contractors, but the money did not always reach the head of the State intact, and I doubt whether any of them ever received as much from their forest in any year as they now reap annually and permanently. In two instances within the last few years the Government of India have decided that jagirdars and chiefs of Feudatory States have no right to endanger the permanent value of their forests by excessive exploitation, and it may be hoped that sooner or later this rule will be generally applied.

The influence of the Indian Forest Department has also extended beyond the seas. Siam has been officered by Indian Forest Officers and men trained at Dohra, the Cape Colony and Ceylon have drawn their Conservators from our midst, and other countries and colonies have profited by advice given to them by Indian Forest Officers on special deputation.
